

Advisory Committee on Acoustic Impacts on Marine Mammals

Sponsored by the Marine Mammal Commission

**Initial Meeting
February 3-5, 2004
Bethesda, Maryland**

Final Meeting Summary

Prepared by the Facilitation Team of

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April 30, 2004

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Initial Meeting

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Meeting Summary

OVERVIEW OF MEETING OUTCOMES

The first meeting of the Advisory Committee on Acoustic Impacts on Marine Mammals was held on February 3-5, 2004 in Bethesda, Maryland. The meeting facilitators developed a comprehensive summary of the meeting as well as this brief overview of the highlights. The complete summary follows this overview.

1. Clarified goal of Advisory Committee process

- The goal of the Advisory Committee is to produce a strong, credible report for the Marine Mammal Commission (the Commission) summarizing what is known and not known about acoustic impacts on marine mammals, what the research priorities are, and what management and mitigation solutions exist for avoiding impacts. The report will outline all consensus achieved and will describe areas of disagreements. The Commission will forward the Committee report to Congress and the interested agencies, along with any additional recommendations they may desire to make.

2. Clarified role of Committee members

- The role of committee members is, to the maximum extent feasible, to represent their organization or constituencies and to create a final report that will be supported and implemented.

3. Developed information base for future discussions through presentations that covered:

- A. Basics of sound in water
- B. Overview of sound sources
- C. Characteristics of sound from oil and gas, Navy, shipping, and academic research activities
- D. Impacts of sound on marine mammals, including background on marine mammal hearing and field observations of impacts, auditory impacts, non-auditory physical impacts, and behavioral impacts.
- E. Overview of relevant government programs, including Marine Mammal Commission, National Marine Fisheries Service, U.S. Fish and Wildlife Service, Minerals Management Service, National Science Foundation, U.S. Navy, and California Coastal Commission
- F. Environmental group perspectives on sources, impacts, and government programs
- G. Oil, gas and marine transportation industry perspectives on government programs

4. Began review of, discussed and reached preliminary agreements on Sections 1 through 4 of the proposed Operating Procedures, to be continued at Meeting 2.

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The revised version of the Operating Procedures is Attachment 4 in this meeting summary. Key points of discussion included: purpose, goal, and structure of the Committee, responsibilities of Committee members, decision making procedures, and the role of alternates.

5. Commissioned Subcommittee on Assessment/Synthesis of Current Knowledge

- The charge to the Subcommittee and the membership are outlined in the last few pages of the meeting summary.

6. Action Items

- Distribute stranding reports for Bahamas and USS Shoup. [The Shoup report was released and distributed to Committee members and alternates on February 9. The Bahamas final report not yet available.]
- Navy to provide follow-up information for questions about whether their marine mammal observation protocols could be provided to the Committee, about whether sonar operators are trained in marine mammal detection, and the requirements of the Marine Mammal Protection Act as they apply to Defense Department activities.
- NOAA Fisheries to provide a list of permits involving sound, including any that were denied.
- Facilitators to provide meeting summary.
- Subcommittee on Synthesis of Current Knowledge to, as a first step, develop a summary of what is known and what are the areas of uncertainty and disagreement, based on National Research Council reports.

7. At various times during the meeting, Committee members identified specific issues to discuss at future meetings. The list below records those suggestions for future reference.

- What species, impacts and issues are highest priority for research (acute and chronic)
- Centralized database for reference materials and studies; categorize by peer-reviewed and not peer-reviewed, etc.
- Consider recommending a research priority on additional replication of hearing studies and ways to address barriers to that research;
- Work further on assumptions and results in Hildebrand draft overview of sound sources
- Look at systems for geographical and seasonal avoidance areas, considering both distribution and abundance of species and siting parameters for noise producing activities
- Ethical guidelines re: research and funding of research on stranded and captive animals and animals in the wild
- Stranding response issues: international reaction teams, enhanced emergency response networks, ABR guidelines, etc.
- Adequate population studies and trend data re: reproductive success
- Stock assessment improvements
- International forums for discussing policy and science issues
- Additional data points re: rising acoustic levels in the ocean
- Define peer review

**Advisory Committee on Acoustic Impacts on Marine Mammals
Initial Meeting
February 3-5, 2004**

Meeting Summary

The first meeting of the Advisory Committee on Acoustic Impacts on Marine Mammals was held on February 3-5, 2004 in Bethesda, Maryland. The Advisory Committee was convened by the Marine Mammal Commission and is comprised of a diverse group of experts and representatives of producers of sound in the marine environment, government agencies with responsibilities or activities significant to marine mammals, academic researchers, and environmental and animal welfare groups (List of meeting participants can be found as Attachment 1). The objectives of this meeting included:

- To develop and agree on the scope of the Committee's efforts and the goal for the process
- To provide a common information base for the Committee to use as it works towards its goal
- To discuss the Advisory Committee process and structure and develop mutual expectations among members regarding how they will work together toward a final product

This document provides a summary of the presentations and discussions at this meeting.

DAY ONE – Tuesday, February 3, 2004

Welcome and Introductions

John Reynolds, Chairman of the Marine Mammal Commission, opened the meeting by thanking people in advance for the valuable time they are committing to the Advisory Committee effort. He noted that Congress asked the Marine Mammal Commission to conduct this dialogue because a variety of human activities are increasingly impacting coastal and marine environments, and the impacts from these activities, especially on marine mammals, require complex analysis and management strategies. In the last few years, much attention from the press has been focused on acute impacts, especially related to strandings. However, what doesn't get media attention may be more important: namely, sub-lethal effects of multiple sources and chronic sound in the marine environment. The Commission expects the Advisory Committee effort to look at the full range of impacts, including acute and chronic, lethal and sub-lethal at both the individual and population levels, and at direct and indirect impacts for the full suite of marine mammal species.

The Commission has, for decades, advocated and promoted proactive and farsighted approaches to addressing marine mammal protection. If policy waits until crises arise, solutions become expensive and are dictated by courts. Dr. Reynolds noted that the Commission desires engagement with all stakeholders through this Advisory Committee to identify solutions for the long term regarding acoustic impacts on marine mammals. The Commission will submit a report to Congress, and as much as possible, it would like to forward consensus recommendations and ideas from the Committee with that report. The Commission also realizes that there may be continuing disagreements, which also will be reflected in the report to Congress.

Dr. Reynolds expressed the hope that the outcome of this effort will focus on measurable and cost effective solutions that reflect a balance rather than a polarity of the different values and perspectives at the table, that allow human activities to continue, and that minimize impacts on marine mammals and their ecosystems.

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David Cottingham, Executive Director of the Marine Mammal Commission, thanked the group for their assistance to date in putting together the Committee. He explained that the group is representative of very diverse expertise and interests drawn from leading experts in the field. Mr. Cottingham noted that he is cautiously and enthusiastically optimistic about the potential for the Committee. The *Assessment Report*¹ prepared by the facilitators prior to convening this meeting indicated several common goals among the various interest groups, including the desire to work together outside the courtroom and the value of a good exchange of information on topics related to marine mammals and sound. Interviewees generally agreed that this type of forum would have value in advancing the understanding of what we know and do not know, prioritizing academic research and reducing impacts to marine mammals in the meantime.

The Marine Mammal Commission is an unusual organization. It was created in 1972 by the Marine Mammal Protection Act, and given an oversight role for federal programs addressing marine mammals. It has no regulatory authority itself, but provides comments to the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, the Minerals Management Service and the Navy on their research, management and mitigation programs. Cottingham noted that the Marine Mammal Commission is uniquely appropriate as a sponsor of the Advisory Committee effort, and that he looked forward to working with the Committee towards a successful outcome. He introduced and acknowledged Erin Vos, Sound Project Manager for the Commission, who has been and will be key to the Commission's support of the Advisory Committee.

Suzanne Orenstein, Lead Facilitator, introduced herself to the group, as did **Lee Langstaff** and **Linda Manning**, the two other members of the facilitation team. Ms. Orenstein explained that the neutral team was hired through a contract with the U.S. Institute for Environmental Conflict Resolution, and that they view their role as working for the whole Committee, not just for the Commission. The facilitators will work to ensure that conversations are focused and on topic, and that the dialogue and the group is balanced. Committee members were asked to briefly introduce themselves and note what they hoped the Advisory Committee effort would achieve. The approximately 80 observers were also asked to stand and state their name and affiliations. (A list of observers is included in Attachment 1).

Agenda and Protocols for this Meeting

Suzanne Orenstein reviewed the goals for this inaugural meeting of the Committee: to reach agreement on the scope and range of the effort ahead; to have a meaningful exchange of information about the substantive issues; to develop a common language and vocabulary; to discuss roles and responsibilities of committee members; and to establish a working relationship.

She briefly reviewed the agenda for the meeting (see Attachment 2, or go to www.mmc.gov/sound). She then briefly reviewed key protocols for the meeting and noted that the Committee would devote more time on the morning of the third day to the discussion and adoption of formal Operating Procedures. Until that time the facilitation team asked the participants to adopt the following protocols:

- All views are important. Participation and “air time” should be balanced equitably.
- Expect, respect and accept disagreement.
- Find ways to disagree that are constructive. When disagreements arise, reduce defensiveness by first saying you disagree, and then talking about why you disagree and not talking about or for the other party.
- Be tough on issues, not on each other.

¹ Available at www.mmc.gov/sound/documents.html

Purpose and Goal for Advisory Committee

David Cottingham began by giving the Committee a brief history of how this Committee was formed. The 2003 Omnibus Appropriations Act included an earmark for the Marine Mammal Commission to fund an international conference or series of conferences on the impacts of anthropogenic sound on marine mammals. The congressional committees in both the House and the Senate were looking for a different approach to understanding and addressing this issue, one that was based on sound science and reflected concerns for marine mammals, but that did not unduly impede human activities. They also wanted to better understand research priorities.

When the bill passed in March of 2003, the Marine Mammal Commission started consulting with constituent groups. Most recognized the need for a new forum for discussion. The Marine Mammal Commission then consulted with the U.S. Institute for Environmental Conflict Resolution, a federal agency in Tucson, AZ that specializes in helping other federal agencies address complex environmental issues. Working in cooperation with the U.S. Institute, the Commission initiated a national Request For Proposals process and selected the facilitation team. Some people now on the Advisory Committee were part of the interview and selection process.

In September and October the facilitation team conducted over eighty interviews across a wide variety of interested and affected parties to arrive at an Assessment Report that was distributed to all interviewees and is posted on the Commission's web site. This report concluded that there was significant commitment to this effort and a high likelihood of success. As a result, the decision was made to charter a Federal Advisory Committee and to appoint this panel. The Committee members were selected after considering several key factors, including balance among interests, ability to represent constituent groups in a broader context, demonstrated leadership in collaborative processes, and credibility within their constituencies.

The Commission's goal for this effort is to move beyond the National Research Council reports by analyzing and building on the results of those three reports, consulting additional sources and stakeholders, and developing a recommended plan for moving ahead on research strategies and management and mitigation issues.

The Marine Mammal Commission will be an active participant in the Committee in order to better ensure that its Commissioners and Committee of Scientific Advisors are involved throughout the process and informed of progress and issues. John Hildebrand, a member of the Commission's Committee of Scientific Advisors and a Scripps oceanographer who specializes in marine acoustics, is a member of the Committee. The Commission has also formed a subcommittee of its Scientific Advisors to foster their full engagement and ensure that the Committee's product will be one that the Commissioners will be able to endorse. The product of this Committee is intended to be a stand-alone document from the group and will reflect all consensus opinions of the group, as well as areas of disagreement. In areas where there is not consensus, disagreements will be reflected and the Marine Mammal Commission may make its own recommendations to Congress and the Agencies.²

² Further clarification of the Commission's intentions regarding the Committee's product were discussed at later points in the meeting, including in the negotiation of the proposed Operating Procedures. The language agreed upon in Section 4 of the Operating Procedures is as follows: "The Commission intends to use any recommendations on which there is consensus in its report to Congress. On issues where the Committee does not or cannot reach consensus, the disagreements will be described in the Committee report. The Commission will include those disagreements in its report to Congress and may develop, if it so chooses, its own recommendations to Congress on those issues."

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Questions, Comments and Discussion regarding Purpose and Goals³

Question: There are a lot of things going on outside of this effort related to marine mammals such as reauthorization of MMPA and the NMFS acoustic guidelines. How do you expect Committee members to interact with these other efforts? **Response by Mr. Cottingham:** We expect you to do what you would normally do. Seismic operators will continue their activities. The Navy will continue its training exercises and research. Environmental groups will continue their advocacy programs. Regulators will continue reviewing and making decisions about sound activities that affect marine mammals. The Commission will continue to review and comment on permit and harassment authorization applications. House hearings on the MMPA are ongoing and it is expected that additional Congressional discussions will go forward in the coming months. The Committee will not have reached agreement on many issues in that time frame. So, individuals are encouraged to participate in outside processes as they normally would, but they should not represent the Committee's deliberations or decisions in any way. Regarding the NMFS guidelines, we plan to cover them in detail at the April Committee meeting.

Comment: There have been several recent attempts to collect and understand the state of the science, including the National Research Council reports and the National Marine Fisheries Service Noise Exposure Criteria development process. We have a good handle on what the gaps are. This effort should focus on the policy choices needed to meet the regulatory mandate and provide policy guidance. **Response by Ms. Orenstein:** We heard that science and policy issues were both important during our assessment interviews. We currently have two plenary meetings focused on science and two focused on mitigation and management. Our second meeting will focus heavily on dialogue surrounding the National Marine Fisheries Service proposed Noise Exposure Criteria.

Role of Committee Members

Suzanne Orenstein reviewed the responsibilities of committee members, which include disseminating information to and representing their organizations and constituencies in Committee discussions and consensus building. There was concern from several Committee members that no one person could legally or realistically represent or get an endorsement from organizations such as the Society for Marine Mammalogy, California Coastal Commission, or academic institutions. Another concern was expressed that organizations not on the Committee may not respect trade offs reached through Committee deliberations, which could result in other parties to the tradeoffs being disadvantaged. It was agreed that under the circumstances, this could not practically be avoided. Ms. Orenstein explained that the goal is to achieve the greatest support possible from the members' organizations and constituencies because that would result in a more durable and powerful final report. Thus Committee members should bring concerns and requirements of their organizations to the discussion to the maximum extent feasible. She assured the Committee that the report will not sugar-coat areas of real disagreement, nor should the Committee settle for the "lowest common denominator" agreement, but it should strive to produce an accurate and credible product. The Committee agreed to share information about its deliberations and network with their organizations and constituencies to bring important issues back to the Committee.

Comment. It is difficult to acquire some of the information on topics related to marine mammals and sound, e.g. papers, reports, grey literature, etc. It would be a valuable role of this Committee to compile all the information used in its deliberations and make it available in the public domain, perhaps on the Marine Mammal Commission's website.

³ All questions and comments summarized in this document represent the perspectives of individual Committee members. No comments are meant to imply or suggest any consensus of views within the Committee.

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Question. How do you see the role of the press? **Response by Ms. Orenstein and discussion by Committee.** Since this is a Federal Advisory Committee, all of our deliberations are open to the public and the press. Where we encounter complaints or controversies, we will work them out together. If members are hesitant to air some issues in public, they are encouraged to use one-on-one conversations or talk to the facilitators for assistance. If approached by the press, Committee members should express their own individual opinions, but should not speak on behalf of others on the Committee or the Committee as a whole, and they should not attempt to characterize others' presentations or views. The group can use the neutral meeting summaries as approved by the full Committee to disseminate information to their organizations and constituencies. There are three things to balance as we report to others about the Committee activities: involvement of constituents; dialogue with each other; and information sharing with the public.

Comment. The group agreed to a request from Marc Dantzker from Cornell Lab of Ornithology to videotape the presentations (only the presentations) for educational purposes.

Presentations

The Committee devoted most of the three days to hearing presentations about the issues they will consider during the life of the Committee. Highlights of each presentation are summarized below. All presentations can be viewed on the Commission web site at <http://www.mmc.gov/sound>. The presentations reflect the views and opinions of the presenters, and do not represent the views of the Committee as a whole, or those of individual Committee members.

Basic Physical Properties of Sound and Propagation - Presentation by Brandon Southall, National Marine Fisheries Service, Office of Protected Resources

This presentation provided the basic physics of sound and general rules by which sound propagates in the marine environment. Using a source-path-receiver organizational framework, Dr. Southall explained the variety of parameters necessary to understand impacts of sound on marine mammals. For example, source parameters include level, frequency and directivity. Path parameters include ambient noise levels and physical characteristics of the environment that affect signal propagation. Receiver parameters include species-specific hearing capabilities and how noise exposure affects hearing, as well as motivational or experiential factors. In a nutshell, he noted that the "effects of noise on marine mammals depend (at a minimum) on sound frequency, exposure level, and duration as well as range from an animal and its hearing ability, not simply on source level! Assigning a single received level as the general onset of behavioral disturbance or injury is too simplistic."

Dr. Southall outlined for the group the basics of physical acoustics including important concepts such as wavelength (distance between sound waves) and its relationship to frequency or "pitch" (rate of oscillation), and amplitude or "loudness" (measurement of pressure). He noted that sound travels about four and a half times faster in water than in air, that the speed of sound increases with temperature in either media, and that low frequency sounds tend to propagate farther than higher frequency sounds. He went on to explain various calculations used to describe sound pressure and intensity levels in air and water and that there are various ways to measure and report intensity and pressure. In some cases, peak pressure is the most important relevant measurement, while other times overall energy flux density is useful in assessing potential impacts (e.g. when comparing impacts of sound exposures of variable duration).

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He compared typical source levels and frequency ranges for examples of sounds made by marine mammals (e.g., Weddell seals and humpback whales) and human underwater sounds (e.g., large ship, air gun array, and Low-Frequency Active sonar). He concluded that received noise levels depend on many complex factors and while received levels generally decrease rapidly with distance from a sound source, the presence of reflective and refractive boundaries can significantly affect the level, duration, and directionality of a propagating sound.

Question. Which factors are the most limiting to our understanding? **Response by Dr. Southall.** The field of acoustics is further along than our understanding of acoustic impacts on marine mammals. On issues such as hearing, temporary threshold shift and auditory masking, we only have data on a few species and for those species, information is based on very small sample sizes, sometimes a single individual. We also need more information on permanent threshold shift (PTS). Since we do not know much about this area, we either need to measure PTS or model it from temporary threshold shift information.

Comments.

- Agree that not only are data on impacts limited, but we also have limited understanding of the data we do have.
- We cannot assume that the models for calculating sound level and intensity for single sources can be easily applied to multiple sources like an air gun array.
- We have a very limited understanding of what causes behavioral shifts.
- This was an excellent presentation that should answer a lot of questions that have been confusing up until now.

Overview of Sound Sources in the Marine Environment - Presentation by John Hildebrand, Marine Mammal Commission & Scripps Institution of Oceanography

Dr. Hildebrand began his presentation by explaining two types of sound energy, kinetic (as expressed by velocity) and potential (as expressed by pressure). A hydrophone only measures pressure, and is not capturing the kinetic energy. He went on to explain that there is a loss in acoustic intensity when sound passes the sea-air boundary, greatly reducing the sound heard above water from an underwater source. He noted that some sounds occur in a single source or ping and others occur in an array of sounds or multiple sources. Considering these complexities, we need a set of tools to better understand how sounds relate to impacts on marine mammals, and how we can compare different acoustic sources.

Dr. Hildebrand then reviewed the Wenz ambient noise curves with the Committee, showing the sound pressure and frequency of various types of natural and anthropogenic sound in the ocean (e.g., shipping, surface motion, rain, earthquakes). One study of ambient noise in the ocean, based on a single point, indicates that ambient noise in the Northern Hemisphere was about 10dB higher in 2001 than in 1964. This is believed to be due to increased shipping traffic. This means that the intensity of shipping noise has increased in the Northern Hemisphere by approximately 3dB per decade over the last 30 years. Dr. Hildebrand also noted that ambient noise levels in the Southern Hemisphere are lower than in the Northern Hemisphere, and that this difference is attributed to shipping levels. To provide the group with an experience of some of the sounds in the marine environment, Dr. Hildebrand played brief recorded segments from various sources of sound, including an earthquake, rainfall, a blue whale call, bottlenose dolphin clicks and whistles, a ship, an airgun array, and a naval sonar.

Dr. Hildebrand presented two tables comparing selected anthropogenic sound source levels at various frequencies and estimating the sound energy produced per year by those sources. For the annual sound

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energy production table, he provided his assumptions in a spreadsheet and noted that this table was a very preliminary and rough attempt to develop a comparison model for the Committee to consider and improve if it so desired.

Question. Was the volume setting on the recordings normalized or emphasized in any way? **Response by Dr. Hildebrand.** The recordings were not normalized for distance or ambient noise. Other members noted that this type of demonstration is easy to distort.

Question. Did the 2003 National Research Council report address this type of ocean noise budget?

Response by Gerald D'Spain. No. That panel did not create estimates of the overall noise budget.

[Revised in response to a comment on the meeting summary from another NRC panelist that the ocean noise budget could have been within the panel's purview, but was not addressed in the panel's report.]

Comments.

- Several Committee members noted that they did not agree with or did not understand the assumptions made in compiling the sound energy per year table and that they question the goal for developing such a budget and how it related to the assignment of this Committee. Others expressed the view that it would be useful to have a sub-committee with broad representation work with the assumptions and values assigned. Specific comments about the table included: consider adding all natural sounds such as shrimp and porpoise, rain, wave action, lightning, etc.; consider adding all types of vessels together; and review the assumptions about the nature and duration of seismic inputs. It was also noted that even with estimates of total energy, it is important to look at the relative impacts of the various sources on marine mammals. There was a suggestion that Dr. Hildebrand consult with experts and work further on his table.
- One Committee member registered surprise that there was only one data point available to look at historical trends of ambient noise overtime, and thought that the SOSUS arrays should have produced additional data. He suggested that the Committee should look to see if there are other data available.

Panel: Uses and Characteristics of Anthropogenic Sound in the Marine Environment

This session included presentations about the sources and characteristics of anthropogenic sound in the marine environment. The sources discussed were oil and gas exploration and production, Navy activities, shipping, and acoustic methods used in research. There was also a presentation of environmental group perspectives on sound sources. As noted earlier, the full presentations are posted at www.mmc.gov/sound.

Marine Noise and the Offshore Oil & Gas Industry: Activities and Sources -

Presentation by Jim Ray, Shell Global Solutions, U.S. and Phil Fontana, Veritas

Dr. Ray provided an overview of the sources of sound in oil and gas exploration and production activities. The offshore oil and gas industry is geographically diverse (e.g., arctic to tropics, coastal to deep ocean) and includes a wide range of noise producing activities (e.g., exploration, development, production and transportation). The industry operates in areas where marine mammals live and travel (e.g., sperm whales in the Gulf of Mexico, bowhead whales in the Beaufort Sea). Specific activities and sources of sounds include ships of all sizes, fixed wing aircraft, helicopters, drilling and anchoring noise from platforms, diesel and turbine engines, island and causeway construction, construction of subsea

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infrastructure (e.g., pipelines), and removal of equipment using explosives. Some sound characteristics outlined in the presentation are listed below.

- Platforms (bottom-founded; drilling): strongest tones near 5Hz (119-127 dB)
- Drilling vessels: broadband levels attenuate to ambient levels by 1 km for semisubmersible drilling rigs, noisier for drill ships
- Production platforms: strongest tones from 4.5 to 38 Hz, peaks between 50-500 Hz
- Supertankers: peak in 100 Hz range, approx. 170-190 dB; thrusters with higher frequencies sometimes add 10 dB; small boats also have a higher frequency;
- Helicopters: generally below 50 Hz, approximately 150 dB at the source, many variables
- Fixed wing aircraft: most less than 500 Hz, approx. 150-160 dB
- Medium to large boats: tones dominate to 50 Hz, broadband to approx. 100 kHz, peak 50-150 Hz.

Mr. Fontana then described the characteristics of seismic surveys and discussed marine seismic surveys' sources of acoustic emissions. Seismic survey vessels in operation today have been designed to minimize ship-radiated and cavitation-induced noise for data quality purposes. The purpose of such surveys is to create a 3-D acoustic image of the earth to look for likely sources of oil. Contrary to some belief, the seismic vessels are not generating an explosion, detonation, shock wave, or sonic boom-type of disturbance, but rather a disturbance more akin to popping a balloon, with air going from a high pressure to a low-pressure environment. Because of the difference in acoustic impedance between air and water, 1000 times more pressure is required in water to produce a sound intensity equal to a sound in air.

There are various types of seismic survey emissions. They are characterized as follows:

Survey Vessel Radiated Noise	1-150 Hz	<170 dB	continuous
Seismic Airgun Sources	5-400 Hz	<235 dB	impulsive
Acoustic Positioning Devices	50-100 Hz	<190 dB	impulsive
Echo Sounders	12 kHz 200 kHz	<210 dB <215 dB	impulsive
Acoustic Current Profilers	>1 mHz	?	impulsive

Mr. Fontana reviewed the pressure signature of a single air gun, which consists of an initial pressure pulse that decreases rapidly in amplitude over a matter of milliseconds. Airguns are almost always used in an array that is designed to synchronize at the initial pressure pulses from each airgun and attenuate following bubble oscillation pulses. He noted that the sound pressure of the quoted source level is never realized at any point in the water column. In the far field, the output of an array decreases as distance increases, with the maximum pressure in the water believed to be about 1/10th less than predicted by the point source assumption. This is because of near-field versus far-field considerations. Further, Mr. Fontana described the effects of directivity on sound fields, pointing out that mitigation strategies should consider these complexities. He also presented a measurement that indicated that airgun array signatures contain little high-frequency energy.

Mr. Fontana also presented a comparison chart of the normalized sensitivity spectra for toothed whales (odontocetes) with the output from a typical deep-water air gun in the Gulf of Mexico. He argued that there is little spectral overlap between known odontocete audiograms and airgun sound production.

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Question. Which figures in this presentation are measured, and which are modeled? **Response by Mr. Fontana.** The airgun data are modeled. The high-frequency airgun signature presented here was measured in the Gulf of Mexico.

Question. Where does the oil industry operate? **Response by Mr. Fontana.** Seismics can operate in the central and western Gulf of Mexico, and there is some small, seasonal work in Alaska. There are moratoria on seismics in the eastern Gulf of Mexico and on the east and west coasts. The U.S. gets 25-30% of its domestic hydrocarbon production out of the Gulf of Mexico.

Question. There are a number of figures in the presentation that may be problematic. For example, there are sperm whales in the Gulf of Mexico, yet they don't appear on the comparison chart. **Response by Mr. Fontana.** As noted in the presentation, the chart does not reflect all species in the Gulf of Mexico. There is no audiogram available for sperm whales, so they are not included.

Navy Generated Sounds in the Ocean - Presentation by RADM Steven Tomaszewski, Oceanographer of the Navy

The U.S. Navy's mission is to maintain train, and equip combat ready forces capable of winning wars, deterring aggression and maintaining freedom of the seas. They achieve this by maintaining, training, and equipping combat-ready forces. A major new threat in both the deep ocean and shallow coastal waters are quieter diesel submarines that are modern, technologically sophisticated, relatively cheap and available worldwide. Today 45 countries have a total of 380 submarines. The U.S. has 69. The U.S. Navy uses many tools to help detect these submarines including active and passive acoustics, radar, magnetic tools and visual spotting.

Most of the Navy's sonar use is passive since Navy ships prefer to remain silent. However, active sonar is used in exercises and training, research and development and real world operations. As of 2 February, 2004 the Navy had 294 ships and submarines, 58% of which are equipped with sonar. On 2 February 2004, 131 Navy vessels were underway, and approximately 77 of those underway have sonar. The characteristics of the active sonar are as follows:

- High-frequency, > 10 kHz, used for mine hunting, torpedoes, and fathometers. The acoustic energy is greatly attenuated. Typical range is < 5 nautical miles.
- Mid-frequency, 1 kHz to 10 kHz, used on ships and submarines for force protection and tactical prosecution. It has moderate attenuation. Typical range is approximately 30 nautical miles.
- Low-frequency, <1 kHz, used for long-range search and surveillance. It has less attenuation. Typical range is 10s to 100s of nautical miles.

The Navy uses mid-frequency active sonar to locate submarines. It is often used in conjunction with passive systems and has been in operation since the 1940s. One hundred and sixty-nine of 294 vessels have mid-range sonar. Mid-range sonar will not be replaced by low-frequency sonar. It is used selectively and is active about 10% of the time at sea.

RADM Tomaszewski noted that the Navy needs low-frequency sonar to locate submarines outside their effective weapons range. As quieter submarines have shortened detection ranges and could threaten

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Navy forces at sea (and therefore the nation), longer-range detection is needed to provide the Navy with many hours to react to a situation.

The Navy needs to train its personnel in as realistic a world environment as possible. Simulators are not nearly as effective. Since the Navy is a rotational force, inter-deployment training cycles, including sonar training, are constantly underway.

Other Navy sources of noise in the oceans include systems tests and evaluation, ship shock trials, SINKEX (sinking a decommissioned ship at sea); and live fire training.

Question. What is the tactical geographic range of diesel submarines owned by other countries?

Response by RADM Tomaszewski. This varies by the type of submarine and how long they can remain submerged. The German 209 can stay underwater for 10 days and can be at sea without resupplying for 7 months.

Question. Can you describe the sound from ship shock trials and SINKEX? **Response by RADM Tomaszewski.** In ship shock trials, we place a charge at the surface and observers on the ship record what happens. The tests are conducted 3-5 times at weekly intervals (minimum) with an explosive charge of approximately 10,000 pounds for each test. SINKEX is when the Navy tows a ship hull out to sea, where sailors use it for surface and air target practice and a submarine then sinks it. Both exercises require environmental permitting. We spend a lot of time doing aerial reconnaissance to make sure there are no marine mammals or other ships in the vicinity.

Question. It seems that mid-frequency sonar causes a problem for some marine mammals. How have the Navy's practices changed in light of stranding events? **Response by RADM Tomaszewski.** We don't go back to the Providence Channel! The Navy's response involves three components: planning, detection, and operations. We have been working with the National Marine Fisheries Service (NMFS) to get data on where the animals are so that we can better plan to conduct operations in areas where there are fewer animals. We have lookouts posted 24 hours a day who spot whales. These spotters must have 200 hours of on-the-job training before they can spot solo. They use specific tools to help identify particular species. We use our passive sonar to detect whales and use pre- and post-event monitoring. We are in the process of developing a protocol for marine mammal detection and avoidance, to be released fleet-wide this spring. Finally, we have operational restrictions in the vicinity of marine mammals through a buffer zone; alterations and delays of operations; reduced power to sonar and duty cycles; limited operations at night in severe weather conditions; training in deep rather than shallow water; and simulations of restricted channel transits.

Question. Are there any areas that are now off limits to mid-frequency sonar? **Response by RADM Tomaszewski.** Yes, the New Providence Channel (Bahamas). We historically never train in the Gulf Stream. **Response by Frank Stone.** Between November and April, activity in right whale habitat is restricted.

Question. Many military activities are international. What do you do when you are operating in conjunction with different nations and different rules? **Response by RADM Tomaszewski.** Our goal is to use the most protective measures, in spite of different, less restrictive rules in other countries.

Question. What is the effectiveness of passive acoustics as a mitigation strategy? **Response by RADM Tomaszewski.** It does not work well if you want to determine the precise location of something like a submarine. However, for submarines, passive acoustics are good when you want to avoid detection

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yourself. SOSUS is used to track migrating whales using passive acoustics. It could provide valuable data.

Uses and Characteristics of Anthropogenic Sound in the Marine Environment: Shipping Generated Noise - Presentation by Kathy Metcalf, Chamber of Shipping of America

Ms. Metcalf noted that the shipping industry represents a huge unintentional sound source and the industry as a whole has not yet understood the importance of this issue to them. She provided an overview of the types of commercial ships currently being used, including large and small commercial, military, research, utility craft (dredges/tugs), and recreational vehicles including personal watercraft. There is a general trend for large commercial ships to move from steam to diesel, with a few gas turbines, but not many because they are expensive. Large commercial ships include tankers, bulk carriers, freighters, containerships, roll-on/roll-off cargo ships, and cruise ships. Tankers and freighters use similar types of equipment and thus produce similar types of noise. Small commercial ships include ferries, fishing vessels, offshore supply vessels, inland and coastal tug/barge units, and coastal or inland cruise ships. Some of these smaller commercial vessels are particularly noisy when hooking up.

Larger ships have large propulsion systems and hull surface areas. Due to cost they lag behind military vessels in performance by about 30 years; they travel at about 15-17 knots. Container ships can travel at between 25-30 knots but often travel more slowly in order to avoid the increased fuel consumption.

The activities that produce sounds on ships include propeller noise and cavitation, propulsion machinery including engines, auxiliary machinery (e.g., pumps, generators, blowers), cargo equipment (e.g., cranes and lifts-- minimal during transport), the hydrodynamic flow over the hull, and depth finders. The type of vessel dictates the type of additional auxiliary equipment needed such as generators. The type of vessel also dictates whether the ship will travel all over the globe (e.g., tramp) or be more targeted (e.g., time chartered or dedicated transit vessels on regular routes). The noise characteristics of certain types of ships are more predictable than others.

The characteristics of ship-generated noise include broadband generation and sharp peaks (tones). Noise is distributed over wide geographic areas, namely great circles of transoceanic routes and coastal rhumb lines. Few vessel-specific sound profiles have been developed in commercial shipping. Eighty to 85% of ship-radiated noise is attributed to broadband and tonal components produced by cavitation. Variation in noise production is due to differences in speed, load condition, onboard activities, overall condition and maintenance of the vessel. There are approximately 80,000 large commercial vessels worldwide.

Some of the policy and scientific issues associated with noise generated by commercial shipping include:

- There are varying jurisdictions and legal authorities to regulate on the high seas, in coastal waters and in exclusive economic zones that may overlap or conflict;
- There is a lot of variability among ship designs – most are custom built;
- Most of the large, commercial shipbuilding yards are overseas, making it more difficult to deal with ship building industry practices;
- Shipping is an international business that demands international solutions;
- There are potential conflicts with recommendations to use noise to promote marine mammal avoidance behaviors (e.g., North Atlantic right whales);
- Ships are getting bigger; and
- Ninety percent of the world's trade is carried by sea, with a projected doubling in the next 20 years.

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Question. Are there any regulations affecting ships that deal with noise in water? **Response by Ms.**

Metcalf. No, there is more concern in the industry about economic efficiency and safety. Military vessels have more incentive to be quiet, but noise is not a big issue in design for the industry. However, noise is a ripe issue. Environmental issues in general are currently under discussion in the International Maritime Organization (IMO) as it relates to the United Nations Convention on the Law of the Sea (UNCLOS).

Question. What about regional agreements such as in the Mediterranean or the North Sea that prohibit marine pollution including energy? Does the Law of the Sea have a similar definition of pollution?

Response by Ms. Metcalf. The European Union proposed a sensitive sea area from Gibraltar to the English Channel/North Sea, principally focusing on protection of the area from environmental releases from vessels, but the international community is wrestling with how to balance environmental protection with freedom of the seas.

Question. How big is the U.S. merchant fleet? **Response by Ms. Metcalf.** Approximately 354 vessels, with more than 100 in lay-up. It is a miniscule proportion of the worldwide fleet. This number does not include smaller vessels that carry coastally, or on inland routes between U.S. ports, which are required to have a U.S. flag.

Question. If you were to design an international implementation plan to address marine mammals and noise, how would you do it? What organizations would you involve? **Response by Ms. Metcalf.** I would involve the International Maritime Organization when looking at a control and management strategy, and work with the United Nations to look at the biology of the issue.

Question. If 80-90% of noise is cavitation and 90% of our goods are transported by ship, that is a large source. Could the U.S. say that ships coming into our ports must meet certain noise standards, similar to requirements for double hulls after the Valdez incident? **Response by Ms. Metcalf.** The IMO worked on the double hull issue after a serious problem had already happened, but we can also be more forward-looking and preventative.

Comments

- If we want to use the Law of the Sea, the U.S. should sign on to it.
- The National Marine Fisheries Service is actively working with shipping groups to convene a symposium on shipping noise on May 18th and 19th.
- There is a trend toward bigger, faster, and potentially louder ships, but regulation is not developing in synch with this. Enforcement could be done through port entry requirements.

Acoustic Methods Used in Research - Presentation by David Farmer, Graduate School of Oceanography at the University of Rhode Island

There are three main ways in which sound is used for ocean research: propagation studies, backscatter sonar, and passive detection. This presentation will not cover the use of passive acoustical methods. Propagation studies involve transmitting sound from one point and listening at another, and can be used to determine physical properties of the ocean and acoustical transmission characteristics, as well as addressing fundamental questions about the earth's climate, and the calibration of ocean climate models. Source levels for ocean climate studies are around 195 dB centered at 75 Hz, with a bandwidth of 37.5 Hz. Typically, 6-minute transmissions are made at 4-hour intervals on every fourth day. Assuming

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spherical spreading, this type of force would attenuate to 180 dB at about 5.6 meters from the source. Another application of propagation technology is the tracking of neutrally buoyant, battery-operated floats in order to observe ocean currents. Source power levels for these applications are about 170-180 dB re 1 μ Pa at one meter from the source. There are also small-scale propagation studies that are used for a wide range of applications including tracking fish, measuring small-scale oceanic structure, and understanding acoustical propagation characteristics in a limited area. These systems cover a wide range of frequency, source characteristics and power levels, but typically operate at higher frequencies and much lower power levels than long-range systems.

Backscatter acoustics or seismic studies, in which the sound is transmitted and detected at the same location, address fundamental questions about the sea floor, its evolution and impact on life (e.g., earthquake prediction, hydro-thermal vents). Seismic studies are currently being used in a number of research areas that could have far-reaching implications for human society. For example, these methods are useful in detecting gas hydrates, which are carbon sources that could be a future energy source, can cause underwater landslides and tsunamis, and may contribute to global climate change. Recent seismic studies of subduction zones point to the possibility of identifying the characteristics determining whether or not subducted materials slide past each other relatively smoothly, or are 'sticky,' building up energy that when released produces catastrophic earthquakes. Backscatter sonar is also used for depth sounders, fish finders, navigational bottom-detection, detection of sea-floor characteristics and bathymetric mapping, Doppler sonar, and seismic towed arrays. Towed airgun arrays are the typical source used in seismic research. Maximum sound pressure levels for these arrays are 220 dB in the far field. Characteristics of other sources are outlined in Dr. Farmer's presentation slides.

Dr. Farmer described the typical safety radius used in academic seismic research and noted variations needed for deep diving animals. Dr. Farmer noted that there is an urgent need for objective study of the effects of sound on marine mammals, including:

- Masking effects;
- Physiological effects due to chronic background noise; and
- Potential use of low-level sonar devices to learn about the presence of marine mammals, prior to louder transmissions. This could be much more effective than relying on visual detection at the sea surface.

Question. To what extent have mitigation measures been adopted by oceanographers for seismic studies? **Response by Michael Purdy.** All Lamont-Doherty Earth Observatory R/V Ewing studies are permitted through the National Marine Fisheries Service. Other smaller ship operators make decisions on a cruise-by-cruise basis. **Response by James Yoder.** The RV Ewing is not the only ship that does seismic research. The National Science Foundation regularly requires all seismic activities to go through a permit process, and is in the process of preparing an Environmental Assessment for all ships conducting seismic research.

Comments

- We need more data on source characteristics for research applications, including small devices like fish finders.
- The safety radius should be carefully calculated to fit a particular purpose. Using 180 dB without a specific frequency could result in too large a protected area.
- The safety radius for the RV Ewing was self-imposed and chosen to be very conservative because the current understanding of marine mammals is so poor.

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- This Committee should look more into siting parameters and geographic and seasonal restrictions. The Marine Mammal Protection Act should apply to academics as well as other sound sources. And perhaps researchers should consider geographical and seasonal restrictions as safety measures.
- The Committee should look at permitting criteria, especially for studies using low-power sources on a small scale.

Concerns Regarding Sound Sources Associated with Marine Noise Pollution Internationally - Presentation by Sarah Dolman, Whale and Dolphin Conservation Society

Ms. Dolman began by describing the Whale and Dolphin Conservation Society (WDCS), a global charity dedicated to the protection of cetaceans and their environment. WDCS believes that the nature and extent of sound sources in the world's oceans is extensive and intense, and is concerned about the proliferation of intentional uses of sound. These uses include military activities, seismic research, shipping, and other ocean research projects on a large scale, as well as fisheries acoustic deterrents, whale-watching activities, and marine wind farms on a small scale. WDCS is also concerned about the lack of data to allow understanding of impacts on marine mammals from various sound sources, especially lack of information about marine mammal distribution, abundance, biology and ecology. For example, there are no marine mammal population estimates outside of U.S. efforts. Additional research is needed to increase our scientific knowledge of marine mammals and potential impacts including vulnerability of different species, identifying the most vulnerable species and populations of animals. More monitoring is needed to understand the subtler, long term impacts that may be going unnoticed. WDCS understands the need for answers and efforts are needed to further work on sound in mitigation-controlled experiments.

Ms. Dolman gave a brief overview of other domestic, non-U.S. legislation, covering Australia, the European Union, and England and Scotland. In these countries, comprehensive environmental legislation to address noise pollution issues is lacking. These countries lack appropriate legal mechanisms for protection of marine mammals, and have little expert advice available in the policy process. Shipping and fishing activities are uniformly free of regulation, and whale-watching guidelines are limited. Other challenges outside the U.S. include the effective assessment of compliance, the use of the precautionary principle, and the coordination of research.

WDCS advocates that, where possible, research studies should be designed to be benign, passive, and targeted to answer specific questions. Studies should be independent, non-aligned, and peer-reviewed. Finally, research should be coordinated with appropriate legislation to ensure long-term protection. A coordinated combination of studies that ensures a consistency of approach would be of most use.

A holistic approach in international policy decisions is also called for. Efforts must take place both within domestic jurisdictions and internationally, including the high seas, and with an eye toward consistency. The precautionary principle should be employed where data are lacking.

Ms. Dolman also provided copies of an appendix from the paper entitled *WDCS concerns regarding sound sources associated with marine noise pollution internationally* that is a further summary of noise pollution issues (available at www.mmc.gov/sound).

Question. What opportunities is WDCS employing to look at international legislative gaps? **Response by Ms. Dolman.** Australia and the United Kingdom are working on legislative reform. They are considering an act similar to the Marine Mammal Protection Act.

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Question. Is the WDCCS appendix peer-reviewed? **Response by Ms. Dolman.** Yes.

Question. Is there a legal definition of noise pollution? **Answer by Michael Jasny.** UNCLOS has a definition related to pollution in the form of substances and energy, but its application to noise has not yet been tested.

Comment. The Office of Naval Research funds 70% of the U.S.-led research and 50% of the research worldwide on marine mammals. It would be nice to see some matching funds from environmental organizations.

Public Comment Session

In introducing the Public Comment session, facilitator Lee Langstaff explained that Committee members would not be responding directly to public comment, but that all public comment (both written and verbal) will be entered into the public record. She further requested that public commenters speak constructively and to the point. Three individuals provided public comment in this session:

Ted Cranford, San Diego State University, noted that peak amplitude for air guns is designed to happen quickly (i.e. have a short rise time). Since mammals can only protect themselves from impulse sounds that do not happen too quickly (i.e. have a long rise time), this could be a problem. If so, it could be addressed by changing the rise time. Regarding Mr. Fontana's presentation showing the lack of overlap between odontocete audiograms and airgun array sound spectra, it cannot be assumed that simply because they are not overlapping there is no impact. More information is needed. In addition, we have no audiograms for baleen whales and many species of odontocetes. A Committee member added here that the chart of overlap between odontocete audiograms and airgun array sound spectra did not present the data in the same units of measurement.

Chris Clark, Cornell University said that he is glad this forum exists as it is an incredible opportunity for various perspectives to come together to exchange ideas and knowledge. His view is that we are going to get better at describing noise sources, but that the weak link is in understanding population and behavioral impacts on free-living marine mammals. Marine mammals are free-range, long-lived animals that are likely to see two orders of magnitude increase of noise in their lifetime. Restrictions on behavioral research can be onerous. The question is "will our rate of knowledge about the lives, habitats and interdependency of these animals outpace our ability to exploit them?" Habitat preservation and use should be balanced.

Adel Hashad, Space and Missile Systems Center, U.S. Air Force, explained that the U.S. Air Force is proactively looking at noise impacts from sonic booms at missile launches and reentry. In conducting their research, they realized that the models they were using failed to take into account the wavy surface of the ocean, thereby underestimating the extent to which the sound is propagated across the air/water interface. They are hoping to work with the Navy to further develop a program to predict pressure at various depths and do some non-laboratory testing.

Arthur N. Popper, Professor, Department of Biology at the University of Maryland and Ben White, Animal Welfare Institute submitted written comments to the Committee. Each of these are available on the Marine Mammal Commission website.

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DAY TWO – Wednesday, February 4, 2004

Opening Remarks and Review Plans for Day Two

Suzanne Orenstein opened the day with some announcements. She reminded the Committee that from 5:30 to 7:00 PM there would be an informal discussion session concerning the concept of holding an International Workshop as a complement to the deliberations of the Committee. Also, there will be a public comment session from 2:35 to 3:05 PM. Those wanting to make public comment were instructed to sign in at the registration table and told that time would be allocated equally among those who signed up at least 15 minutes before the comment period. There was a request by Amanda Truett of the University of Maryland to audiotape the proceedings for her personal use. The Committee granted permission.

Ms. Orenstein then asked the Committee members for any observations from Day One. They were as follows:

- In listening to the presentations, it was difficult to distinguish between established fact, belief or assumption. There was a suggestion that documents and parts of documents that are assumptions be clearly labeled as such. Others felt that presentations of any type have opinion in them and that the presentations be labeled to say that the materials and opinions contained therein do not reflect the opinion of the Committee. The Committee agreed to label the presentations with this caveat. The Committee members were also reminded to raise questions about accuracy during the question and answer period after each presentation.
- A question was raised as to why, in the session on review of government programs on the third day an environmental organization is the only presenter under the speaking slot for non-governmental organizations. A request was made to change the name of the presentation to reflect its environmental nature or to give equal time to other non-governmental organizations. It was agreed that equal time be given to other non-environmental non-governmental organizations, and the agenda was revised to reflect the addition of a speaker from the oil and gas industry. A suggestion was made to change the agenda, switching the morning and afternoon sessions on the third day. It was agreed that this option could be further discussed after the presenters for those sessions had been contacted. The change was agreed to later in the meeting.

Marine Mammals, Hearing and Sound - *Presentation by Paul Nachtigall, Hawaii Institute of Marine Biology*

Dr. Nachtigall began by noting that hearing and the use of sound have shaped the evolution of marine mammals, including their body structure. For example, the head structure in the bottlenose dolphin is highly specialized in the jawbone and ear to adapt to acoustic uses, and sperm whales have 40% of their body dedicated to producing sound for a variety of uses. Hearing is a necessary component for the use of sound by marine mammals for foraging and echolocation, communication, social behavior, reproduction, parental care, avoidance of predators, and overall awareness of the environment.

Even though these animals are highly evolved to use sound in their environment, we know very little about the uses of sound by specific species of marine mammals. We believe that groups of Hawaiian spinner dolphins use sound to coordinate encirclement of fish for foraging. We believe that mysticetes

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(baleen whales) use low frequency sounds for long-range communications, possibly for finding mates and migration purposes. We believe the other marine mammals use sound to communicate with their young, signal reproductive availability, avoid predators, or engage in male-male competition including activities such as breaching, tail slaps and pectoral slaps which can reach sound levels greater than 180 dB. Marine mammals differ in their production and uses of sound. For example, harbor seals use low-frequency sounds, while bottlenose dolphins use high-frequency whistles and echolocation clicks. There are also likely differences in what marine mammals can hear. It is likely that toothed whales hear best at frequencies in the high ranges, from 10-100 kHz. Pinnipeds likely hear best below 50 kHz and use sound in both air and water. We have never measured the hearing in baleen whales, but we assume they can hear low frequencies based on their physiological structure. In general, it is important to know both the frequency and level of sounds that animals can detect, but we only have audiograms for a few individuals from a handful of species.

Dr. Nachtigall described two methods to test the hearing of a dolphin or whale. One method uses traditional psychophysical trained animal experiments where an animal is trained to respond if it perceives a presented sound. This method produces behavioral audiograms, and is practical for captive species that can be trained, but not for larger or less accessible marine mammals. It takes a couple of years to train an animal to make these responses.

The second technique is called acoustic brainstem response (ABR), in which hearing is determined by measuring the animal's brainwave responses to sound. This is the technique currently used to measure hearing in human babies just after birth and involves measurement with sensors on the surface of the skin. It is a benign and harmless procedure.

Based on limited examples, it seems that marine mammals show shifts in hearing (threshold shifts) like other animals and that the magnitude and permanence of these shifts are dependent on amplitude and duration of the noise. Short sounds (1 sec) can cause temporary threshold shifts in beluga whales if intense enough (>200 dB). A 160 dB noise presented for 50-55 minutes can result in a 5-8 dB temporary threshold shift in a bottlenose dolphin. Elephant seals, harbor seals and California sea lions all show threshold shifts both in air and under water.

Dr. Nachtigall ended by summarizing outstanding issues regarding marine mammal hearing and sound.

- We have audiograms for only 10 of the 80 species of cetaceans, and these are from a handful of individual animals. Since we have not measured hearing thresholds for over 70 dolphin and whale species, we should advocate ABR for as many stranded animals as feasible. ABRs should be viewed as a medical diagnostic test.
- We need to know if strandings are associated with acoustic trauma, and since marine mammal ears are the most sensitive organs to acoustic energy, we need to understand them.
- We know that acoustic intensity levels in the oceans are rising, and it is unlikely that they will soon be lowered or stopped. Perhaps it can be regulated, but to do so we need to understand what limits on levels of acoustic intensity can be scientifically defended.

Question. What parameters other than sample size do you feel are needed to look at to understand natural species variability? **Response by Dr. Nachtigall.** A greater number of samples would help us build reliability over time. I would like to look at whether we would see loss of higher frequency hearing with age or if males would lose hearing more than females. We should consider age, health, life history, and sex, all of which affect individuals differently.

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Question. Can you estimate a variance for bottlenose dolphins' hearing? What is the range? **Response by Darlene Ketten.** Five dB would be within the typical range. Audiograms are intended to be an average, but many more repetitions are needed, as well as audiograms on more species. **Response by Dr. Nachtigall.** It is harder to estimate variance for absolute hearing thresholds than for temporary threshold shifts, where a relative comparison can be done.

Question. ABR use on stranded animals has at times been controversial because of concerns about the humane treatment of animals. What are the standard operating procedures for appropriate use?

Response by Dr. Nachtigall. ABR is appropriate when used as a medical diagnostic procedure. Standard operating procedures are to take care of the animal first, then collect data if it is still possible.

Comments:

- The Committee should look closely at limits to working with captive and stranded animals in order to get experimental repetition.
- There is a critical need for more sensitive studies done at lower levels, where most human noises are made.
- The Committee should consider what might go into the development of reasonable, ethical and practical technical guidelines for ABR.
- The Committee should look closely at this as an area where data are needed, and examine factors that limit data availability.

Field Observations of Impacts on Cetaceans - Presentation by Ken Balcomb, Center for Whale Research

Mr. Balcomb recounted that he has been observing whales in their habitat since 1966, beginning with his work as staff on whaling boats, with the U.S. Navy, and through traditional Japanese whaling practices called "oikomi" drive fisheries. He has observed beaked whale strandings since 1967, which is especially notable since beaked whales are both rare and rarely seen. He has spent twelve winters at sea in the Atlantic and Pacific Oceans. He also conducted photo-identification demographic studies of killer whales in the Pacific Northwest.

In the winter of 1991, Mr. Balcomb initiated a project in the Bahamas to learn about the behavior and life history of beaked whales. By March 2000, the study had photo-identified more than 140 dense-beaked whale (*Mesoplodon densirostris*) individuals and documented a high rate of return to the study area.

Mr. Balcomb described his recent experiences and observations of beaked whale strandings. Between March 15 and 16, 2000, sixteen whales and one dolphin stranded, some live, in the Bahamas. Species included Cuvier's beaked whales, dense-beaked whales, and minke whales. Where possible, Mr. Balcomb preserved the heads or removed the sinus and ear bones for future studies. Simultaneous to this stranding, the U.S. Navy and allies were conducting anti-submarine warfare exercises involving the use of sonar by seven surface combatants and three submarines in the Northern Bahamas (New Providence Channel).

Mr. Balcomb then recounted another event that occurred in May 2003 in Puget Sound in Washington, USA. On May 5, 2003 the USS Shoup was operating SSQ53C sonar in the Haro Strait. Experienced observers and researchers observed that the behavior of whales in the area was unusual, and that the animals seemed distressed. At the closest point of approach, received levels of sonar were measured at approximately 155 dB. A minke whale, porpoises, and killer whales were observed to be fleeing away from the USS Shoup. Sixteen porpoises that stranded before and after May 5th throughout Puget Sound

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have been examined by necropsy. Mr. Balcomb commented that he had not been allowed to participate in necropsies conducted by the National Marine Fisheries Service (NMFS). The results of these examinations are the subject of a report by NMFS, currently being internally reviewed before release (as of January 30, 2004).

Mr. Balcomb provided copies to the Committee of an article entitled, *Mass Whale Mortality: U.S. Navy Exercises Cause Strandings* (Bahamas Journal of Science, Volume 8, Number 2, May 2001), which is available on the Marine Mammal Commission's website.

Question. When you calculated received levels of 160 dB in the Bahamas strandings, where did you assume the whales were? **Response by Mr. Balcomb.** For the dense-beaked whales, I assumed they were in the 500-meter isobath where we had observed they could usually be found. For the Cuvier beaked whales, I assumed they were in slightly deeper waters, which would also be consistent with observations. It is not likely that the stranded whales were exposed to received levels of 180 dB, since in this case the 180 dB zone does not line up with their usual habitat.

Question. Is there any evidence of aversion behaviors at lower levels of sound? **Response by Mr. Balcomb.** Dolphins ride the wake of vessels that create loud, low-frequency sound. I believe that the strandings are not just the result of hearing impacts, and that other causes of the distress may be a part of the picture. Behavioral differences may play a role, or some unique quality or character of the sound.

Question. Do you know the frequency and duration of the sound source in each case?

Response by Mr. Balcomb. For the Bahamas incident, two 53C sonars operated for approximately eight hours at 2.8-3.8 kHz, and two 56C sonars operated with 6.8-8 kHz pulses for 1/10th of a second every 24 seconds. For the USS Shoup, two 53 C sonars operated for approximately five hours at 3.5 kHz. **Response by RADM Tomaszewski.** In the Bahamas, the Navy was doing battle group training for choke point transits using four sonars for 14 straight hours. The USS Shoup used one sonar to conduct mine sweeping exercises in the channel.

Comments

- The Committee should question the need for sonar use in military exercises and look at flexibility around how to avoid areas of beaked whale concentrations.
- Some members noted that they have seen whales and dolphins ride the bow wave of a Navy frigate when sonar was active.
- It is difficult to get access to other countries' land in order to respond rapidly to a stranding event. Quick notification and a coordinated international stranding response effort would help us learn more in the case of future strandings.
- One commenter stated that the whales in the Bahamas and Canaries strandings did not die from acoustic trauma (damage to tissue caused by sound). It was likely something behavioral that caused them to strand. In Vieques, Puerto Rico, the stranded whales were observed to have a hemorrhage in their inner ear that could have been caused by any number of factors. Another commenter responded that the positions espoused by the first commenter are controversial.
- The National Marine Fisheries Service responded to Mr. Balcomb's comment that he was not allowed to participate in the necropsy in the Shoup incident. The NMFS representative noted that Mr. Balcomb was not invited to participate because he had already advocated a position to the media, and NMFS did not want to risk having the outcome of the necropsies criticized as predetermined. The necropsy report will be made public in the near future.

Auditory Impacts of Sound on Marine Mammals - Presentation by Ted Cranford, San Diego State University

Dr. Cranford opened with the caveat that he was only covering odontocetes in his presentation. Hearing loss is normally caused by temporary or permanent damage to the inner ear components. He noted that underwater sound exposure can cause physical injury (including mortality), permanent hearing loss, temporary hearing loss, and masking (interference with the ability to hear biologically important sounds).

In the inner ear, hair cells convert mechanical and hydrodynamic forces within the cochlea into neural impulses received by the auditory nerve. Hair cells are most vulnerable to over-stimulation caused by acoustic stimuli, and damage to them dramatically impacts hearing ability.

Determining threshold shift involves comparing hearing thresholds (minimum audible level of received sound at a particular frequency) measured before and immediately after exposure to underwater sounds. The threshold shift is the difference between pre- and post-exposure hearing thresholds. A higher hearing threshold after exposure indicates a hearing loss. When the threshold does not return to the pre-exposure level, this is termed a permanent threshold shift (PTS). PTS is associated with hair cell loss and permanent damage to the auditory system. If the threshold does return to pre-exposure levels, no permanent injury has occurred in the ear and the shift is termed a TTS, or temporary threshold shift. In research on dolphins and beluga whales, whether threshold shifts occurred was a function of amplitude and duration.

Dr. Cranford discussed his work and that of other scientists using CAT scanning technology to examine the cochlea and associated physiology. He noted the limited number of specimens available for this type of research.

Gaps in current knowledge about auditory impacts stem from a lack of data in certain areas. The best approaches for measuring auditory impacts would include conducting repeatable tests in both laboratory and open-water settings, addressing sophisticated questions about the effects of multiple impulses and intermittent tones, the frequency-dependence of threshold shifts, depth-dependent effects, the fatigue of protective mechanisms, and the difference between short tones and impulses. Where it is not possible to use more empirical approaches, we can apply modeling techniques based on remote imaging (medical CT scans, etc.) and finite element modeling. We can also conduct experiments on stranded animals (stranded whale “action teams”), although this is an imperfect approach. It might also be possible to “dry-dock” large whales for a short period of time in order to conduct tests of hearing thresholds, TTS, and the effects of high-intensity sound.

Question. In the Bahamas stranding, a received level of 165 dB was calculated. Would you predict TTS for those animals? **Discussion by group.** This situation is not simple because it involved relatively unknown species and unknown conditions. In order to predict TTS you would have to add up all the energy for all the pings, not just a single ping, since there were at least 3 sonars active simultaneously. Furthermore, since there are no audiograms for the beaked whales in question, we would have to extrapolate from the bottlenose dolphin audiogram.

Question. Shouldn't frequency also be considered in TTS, not just amplitude and duration? **Response by Dr. Cranford.** Yes, although frequency-dependence is not well-understood. Another factor that may influence TTS is rise time. Amplitude and duration seem to be the most important factors currently known.

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Question. If the noise is outside the hearing range of an animal, does it have an effect? **Discussion by group.** Frequency is extremely important when dealing with threshold shifts. If the frequency of exposure is not in the curve of the audiogram, it is not clear whether the noise will cause damage. With TTS, the greatest shifts happen at frequencies above the frequency of exposure. We cannot generalize effects of impulse noise based on audiograms, which are based on responses of animals to pure tones.

Comments

- The Advisory Committee should have a detailed discussion of the Bahamas stranding and the USS Shoup incident when the reports are released.
- Researchers should look at anatomical evidence of head and neck trauma whenever specimens are available. It is now possible to do scans even on very large animals.

Impacts of Sound on Marine Mammals: Non-auditory Physical Impacts - Presentation by Sam Ridgway, U.S. Navy Marine Mammal Program

Non-auditory physical impacts on marine mammals from sound exposure have received little direct study. Impacts have been suggested from underwater explosions, sonars, and impulse devices employed by the military, industry, and researchers, and have been inferred from terrestrial animal subjects tested in chambers or swimming pools, but rarely in open water.

Underwater explosions produce a brief, very intense shock wave that can kill or cause serious injury to those near the blast. In ship shock trials for the USS Winston S. Churchill, a two-mile safety zone was established to protect marine life.

Experiments on hearing and temporary threshold shift (TTS) have helped produce a baseline for understanding non-auditory impacts of sound, including physiological stress and general health. Simulated impulse (water gun) and sonar exposures in open-water hearing tests on trained dolphins and white whales (belugas) produced TTS at an average level of 195 dB re 1 μ Pa in the mid-frequency range. Single impulses up to 226 dB re 1 μ Pa were tested on a white whale and 228 dB re 1 μ Pa for a dolphin. No short- or long-term auditory or non-auditory injury was found. The effects of exposure are a function of both the sound pressure and the duration. For longer-duration exposure, much less sound pressure is required for the same effect of short-duration exposures.

Beaked whale strandings associated with naval sonar use have led to the consideration of several possible mechanisms of non-auditory physical impacts. We don't fully understand how hearing mechanisms were involved in the sonar-related stranding events (e.g., Bahamas, Canaries). Internal damage to areas such as the lungs, sinuses and intestines could occur from sound pressure as a result of acoustic impacts on air spaces that are acoustically reflective. The National Marine Fisheries Service and Office of Naval Research held a workshop on this potential mechanism of injury. The workshop included discussion of possible acoustic resonance of air cavities caused by sonar, and found that although this mechanism of injury seemed unlikely, additional research was needed in this area.

In addition to the idea of acoustic resonance, other hypotheses for beaching and injury causation include vertigo caused by vestibular insult, and direct injury to the brain or central nervous system. With a 1-second tone from a 200 dB re 1 μ Pa stimulus, eye movements consistent with the Tullio phenomenon (an indicator of vestibular stimulation) have been observed in some dolphins. As hearing deteriorates and the ear is damaged, the vestibular system becomes less competent, thus potentially making older animals more susceptible to insults on the vestibular system. Work done by Yamada and Yoshizaki in

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1959 should be repeated with modern scanning techniques and anatomical reconstructions to better understand vestibular responses.

Studies of stress effects of animals in TTS experiments have shown that levels of catecholamine, epinephrine, and other stress-related hormones increased after high levels of sound exposure, but returned to normal 24 hours later. Stress may affect immune system functioning.

Another hypothesis about potential non-auditory impacts is that nitrogen saturation on deep dives results in decompression sickness. Seals and dolphins are believed to have different protective mechanisms for the prevention of nitrogen super-saturation on deep dives. Experiments with dolphins trained to make frequent dives with short surface intervals showed no ill effects and no sign of decompression sickness. However, nitrogen super-saturation and bubble formation are possible, and a correlation exists between predicted levels of nitrogen saturation and the groups of cetaceans that strand during exposure to mid-frequency sonar. A recent study found evidence of bubbles in the liver and renal tissue in stranded animals, showing that *in vivo* bubble formation and persistence is possible in cetaceans. Dr. Ridgway noted that most toothed whales have several specialized features related to their adaptation to a completely aquatic lifestyle that may give rise to unique impacts. Thus, it should not be surprising that distribution of bubble pathology might be different in cetaceans than in humans and other terrestrial mammals. With the availability of very good portable ultrasound units, assessment of bubbles in various large vessels (e.g., liver) could be made rapidly after the completion of a dive series to test various hypotheses.

Ridgway noted also the need for exercising caution in extrapolating data from one or two individuals of one or two species.

Ridgway provided copies of several papers to the Committee: *Marine Mammal Science* and U.S. Navy Ship Shock Trials (Ridgway and Moore, Marine Mammal Science, Vol. 11, No. 4, October 1995), *Hearing and whistling in the deep sea: depth influences whistle spectra but does not attenuate hearing by white whales* (Delphinapterus leucas) (Ridgway et al., Journal of Experimental Biology, 204, 3829-3841, 2001), *Auditory and behavioral responses of bottlenose dolphins (Tursiops truncatus) and a beluga whale (Delphinapteras leucas) to impulsive sounds resembling distant signatures of underwater explosions* (Finneran et al., J. Acoust. Soc. Am. 108(1), July 2000), *Can diving-induced tissue nitrogen supersaturation increase the chance of acoustically driven bubble growth in marine mammals?* (Houser et al., J. Theor. Biol. 213, 183-195, 2001), *Temporary shift in masked hearing thresholds in odontocetes after exposure to single underwater impulses from a seismic wateregun* (Finneran et al., J. Acoust. Soc. Am. 111(6), June 2002), *Low-frequency acoustic pressure, velocity, and intensity thresholds in a bottlenose dolphin (Tursiops truncatus) and white whale (Delphinapteras leucas)* (Finneran et al., J. Acoust. Soc. Am. 111(1), Jan. 2002), *Noise pollution: a threat to dolphins?* (Ridgway, in Ray and McCormick-Ray, Coastal-Marine Conservation: Science and Policy, in press), *Anthropogenic sound and marine mammal health: measures of the nervous and immune systems before and after intense sound exposure* (Romano et al., Canadian Journal of Fisheries and Aquatic Sciences, in press), and *Temporary shift in masked hearing thresholds of bottlenose dolphins, (Tursiops truncatus), and white whales (Delphinapterus leucas), after exposure to intense tones* (Schlundt et al., J. Acoust. Soc. Am. 107(6), June 2000).

Question. Is the experiment with the explosive charge published? **Response by Dr. Ridgway.** No.

Question. Do you have any speculation about possible causes of fibrocystic bubble pathologies?

Response by Dr. Ridgway. The causes could be bacterial infection, explosion exposure, methane, or other causes unrelated to diving.

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Question. Due to the limitations of captive research on stress, under what conditions can we extrapolate data to compare captive levels to wild levels? **Response by Dr. Ridgway.** There is some data comparing captive and wild animals by Randy Wells and Peter Tyack, and it shows little difference.

Behavioral Impacts of Sound on Marine Mammals - Presentation by Peter Tyack, Woods Hole Oceanographic Institution

Dr. Tyack began by outlining the marine mammal behavioral disturbances that may be observed. The “zones of influence” model of effects of noise on marine mammals includes a zone where the animals will avoid the sound, and a zone of behavioral disturbance. The biggest concern about avoidance involves the potential for permanent abandonment of a habitat, but experiments to investigate avoidance typically study temporary avoidance of areas. Data from a series of censuses suggest that gray whales abandoned a breeding lagoon during a period of shipping and dredging in the lagoon, with reoccupation of the lagoon starting years after the industrial activity stopped. This kind of correlational or anecdotal evidence suggests that intense noise over a long time can cause animals to abandon habitat. Controlled exposure experiments have demonstrated that migrating gray whales alter their migration paths due to stationary sounds of oil industry activities and a low-frequency sonar. This kind of experiment can relate the degree of avoidance response to the received level of sound at the whale with considerable precision. These avoidance responses demonstrated in short-term experiments could decay over time due to habituation, but there have been very few experiments designed to study habituation. They are difficult to do, as you need days or weeks with the same subjects. One study of harbor porpoise (*P. phocoena*) responses to a 145 dB pinger show a strong avoidance response at the first hearing, but the animals appeared to habituate over time and eventually stopped avoiding the sound. In summary, our current knowledge on effects of avoidance responses suggests that avoidance can be used positively to stimulate animals to avoid harm (e.g., weak pingers on nets can reduce entanglement), but that avoidance responses pose a risk if animals abandon important habitat.

Behavioral disturbance can be defined as a disruption of biologically significant activities (e.g., breeding, feeding). The basic activities of individuals that are critical for population health involve growth, survival, and reproduction. Effects on reproduction can be studied in terms of disruption of mating behavior, including mate choice and parental care. One of the best known reproductive behaviors of cetaceans involves the songs of humpback whales which are performed by males during breeding season. Humpback song is an advertisement display that could serve several purposes such as attracting females, assisting females in locating or selecting males, and mediating competitive interactions among males including spacing. Disruption of this song could therefore interfere with reproduction. Controlled exposure experiments have demonstrated that humpback whales lengthen their songs during exposure to low-frequency active (LFA) sonar. One hypothesis about why the whales change their behavior is that the whales are compensating for additional ambient noise, but it is not known whether this change might have subtle effects that are not fully compensated.. Dr. Tyack described another example in which low-frequency calls of a blue whale were tracked for more than 43 days as it swam over 1,700 km. We do not know the critical distance for communication between blue whales, nor the function of these calls, but there is the possibility that the aggregate sound of thousands of ships could interfere with the blue whales ability to find a mate. We do not know whether these whales have compensation mechanisms such as boosting their energetic output in order to increase the volume of their calls to be heard over the increased ambient noise. Dr. Tyack noted that the greatest concern over masking occurs where there is the greatest overlap between frequency range of odontocete hearing and a continuous source of anthropogenic sound.

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Dr. Tyack described the association of mass strandings of beaked whales with mid-frequency naval sonars as an example of how exposure to sound might affect survival of individuals. Some stranded animals in the Bahamas, Madeiras, and Canary Islands had signs of pre-stranding injury, perhaps associated with acoustic trauma or decompression-like syndrome. A primary issue regarding behavioral impacts for beaked whales is whether a behavioral reaction to sound could lead directly to stranding. Alternatively, it is possible that a behavioral response to sound could cause injuries that would make stranding more likely. We must understand the mechanism linking exposure to stranding in order to determine what exposures are safe.

Another example of how sound might impact survival involves the communication systems marine mammals use to maintain contact between mother and young. Dolphins use whistles to maintain contact between mothers and calves. Two important questions to ask are, “When might noise prevent dependent animals such as mothers and calves from maintaining contact?” and “When can these separations pose a risk to the young?” These questions are particularly important in marine mammals that have prolonged periods of parental dependency.

The third way in which disruption of behavior may impact animal populations involves energetics of foraging. Examples of controlled exposure studies on sperm whales using digital acoustic recording tags show promise in helping scientists track and understand functions and costs of behaviors in order to infer the biological significance of behavioral disruption. Initial results from a study of four sperm whales exposed to seismic airguns show little evidence of disruption of the vocalization (“creak”) rates used as indicators of foraging behavior; however, the sample size was extremely small and may not have been independent.

To address concerns and questions about behavioral impacts, Dr. Tyack noted the need for acoustic exposure criteria for different species. In order to make these criteria meaningful we should:

- Map distribution, abundance and dive patterns;
- Improve detection capabilities, especially for submerged animals;
- Test the most sensitive animals;
- Test acoustic criteria for avoidance, not just threshold shift;
- Treat profound behavioral disruption like we would the risk of injury; and
- Develop models to frame costs and benefits in demographic terms.

Question. During the Hawaii LFA experiment, four calves were observed to separate from their mothers. What source levels were used in that case? **Response by Dr. Tyack.** No such separation was observed for the four mother-calf pairs followed by our observation vessel during these experiments. The received levels for the whales under study started low (about 120 dB) and increased to as high as 150 db. With cow-calf communication, we are most concerned about continuous sounds that constantly overlap with the frequencies used by the animals. The LFA signals were transmitted about 10% of the time and had little overlap with humpback vocalizations, so I do not consider this a prime example of concern for disruption of vocal contact between mother and young.

Question. What additional data are needed to get population information that would help us understand population-level consequences? **Response by Dr. Tyack.** We need to look at geographical distribution and habitat usage. This could be done by analyzing existing raw sightings data and doing acoustic monitoring. We need a better measure of reproduction rates – our current methods are very crude. By the time we recognize a change in reproductive rates, it is likely to be too late to stop it.

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Question. What should we do to make sure that we do not hurt a population when we do not have enough information? **Response by Dr. Tyack.** There have been no studies on masking since 1972, even though we have the capabilities needed to perform them. We need to look at this issue in a global, long-term fashion. We should look at this with an eye towards whether there are simple, cheap suggestions we can make to the shipping industry. National Marine Fisheries Service stock assessments have improved in the last 10 years, and could be further improved and used to improve our understanding.

Question. Were sperm whales in your controlled exposure study expected to be habituated to the ongoing seismic activity in the Gulf of Mexico? **Response by Dr. Tyack.** We tried to pick naïve subjects in locations without ongoing seismic activity. However, it is unlikely that the sperm whales we studied had never previously been exposed. It is important to replicate these studies in an area that has never had much seismic survey.

Comments:

- Some of the whales in the Bahamas did not die from stranding, but died in the water more quickly than normal live stranding would have indicated.
- National Marine Fisheries Service (NMFS) representatives noted that they are taking a fresh look at marine mammal stock assessments to see if more can be learned from data that is already gathered about populations. There was a suggestion that the U.S. Fish and Wildlife Service (USFWS) coordinate with NMFS on improvements to stock assessments. USFWS is working with NMFS on revising stock assessment development guidelines.
- It is not enough to make recommendations to the agencies involved—we must ask Congress for the funding needed for research.

NGO Evaluation of Specific Impacts - Presentation by Naomi Rose, Humane Society of the U.S.

Impacts of most concern to the Humane Society of the U.S. include baleen whales exposed to low-frequency sounds and beaked whales exposed to mid-frequency sonar. Baleen whales exposed to low frequency sounds up to 155 dB re 1 μ Pa have been shown to change their vocalization rates, deviate from migratory paths, be displaced during breeding behavior, and lengthen their mating songs. Beaked whales exposed to mid-frequency sonar have suffered strandings of single and mixed species – there is a high correlation between nearby naval maneuvers and these strandings. Animals in these events have had injuries consistent with acoustic trauma or exposure and have possibly been displaced from their habitat. Other examples of marine animal reactions when exposed to anthropogenic sound include orcas and harbor porpoises that are displaced by high amplitude harassment devices, pilot whales changing their vocalizations when exposed to low- and mid-frequency sound sources, odontocetes and pinnipeds experiencing temporary threshold shift (TTS) when exposed to high amplitude sound, and fish suffering internal, eye and ear injuries when exposed to low-frequency sounds and air guns.

The Humane Society of the U.S. has many concerns with research to date. Small sample sizes in experimental studies mean that individual differences have a disproportionate influence in our understanding. Field studies have been short-term in nature and assessed short-term behavioral reactions only; therefore, there are few longitudinal or even multi-season data, and physiological impacts are unknown. Experimental sound characteristics often differ from those of concern (e.g., pure tones v. broadband), and most experimental data are from captive bottlenose dolphins, belugas, or pinnipeds. It is difficult to extrapolate from a few individuals to the population level, or from one species to many. Research to date has addressed limited hypotheses, examined limited parameters, and used limited

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methodologies, leading to limited conclusions. Nevertheless, results have been broadly interpreted by regulatory agencies to justify a permissive approach. For example, it does not appear that any permit requests have been denied.

Dr. Rose noted that the essential problem is that the precautionary principle would favor a conservative, cautious interpretation of research results to date. However, regulatory decisions have been non-precautionary and essentially discount evidence of negative impacts that could affect populations. She argued that precautionary does not equal arbitrary. We must make decisions in the absence of information, and conservative regulatory standards should be established that do not rely on over-interpretation of available science.

Research results to date are necessary first steps, but insufficient to adequately inform regulatory decisions. The goal should be to establish precautionary regulatory standards and mitigation until we have acquired a broader base of information. Some suggestions for addressing the policy problem:

- Coordinate research internationally through academic or other institutions. Encourage cross-pollination of ideas and methods.
- Design multi-season, longitudinal studies.
- Design research programs that examine reactions from as wide a variety of species as practicable.
- Use controlled field studies to complement captive studies.
- Research previously unexamined sources such as shipping and wind turbines.
- Design monitoring programs that record reactions beyond the safety/exclusion zone.
- Establish critical habitat zones where anthropogenic noise would be limited or prohibited.
- Establish an internationally-coordinated standard operating procedure to follow during a mass stranding that may be related to acoustic trauma.
- Establish a neutral body to administer funds for research.

Dr. Rose noted that these suggestions are not a comment on the quality but rather the quantity of available research results.

Comments:

- Others would argue that the National Marine Fisheries Service (NMFS) is too precautionary and does not balance uses equitably. NMFS is looking to be as conservative as necessary to balance mandates. NMFS does deny some permits and in other cases NMFS raises questions about a specific permit application and sends it back to the applicant for revisions, which are never submitted, so the permit application goes no further. In addition, the public does not see the up-front work NMFS does with permit applicants to revise applications and prevent rejections in the first place.
- It may help the perception if NMFS made available a list of permits submitted and those denied. (NMFS agreed to provide this information to the Committee.)
- There are many permits that are desired but never requested because the process is seen as too onerous and expensive (e.g., California moratorium on seismic activities in state waters since an Environmental Assessment was requested in the 1980s).
- Perhaps a screening test for prioritizing research should be: to what degree a specific study will provide more clear information for policy makers.

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- It was observed that there are many definitions of precautionary principle, and that we should be aware that those words mean various things to various listeners. One member offered a definition for it from the 1992 Rio Declaration, Principle 15: “Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”
- The Committee should address, in a substantive way, the ethical questions that arise from research. It is important to examine experimental design.
- The Committee should also discuss how societal ethics balance in the case of the U.S. Navy and marine mammals.
- We should work to coordinate international research. There is a general notion of conservatism in research permits, but we could benefit from being more liberal (e.g., get more data). Many people are leaving the field of captive animal research because of onerous requirements.

Committee Comments at Conclusion of Presentations

In summarizing the presentation on impacts of sound on marine mammals, the Committee developed the following suggestions for further discussion:

- The need for population studies and trend data on reproductive success; discussion of geographical and seasonal issues, species distribution and abundance, and siting parameters
- How to categorize reference materials used by the Committee (peer-reviewed, etc.)
- Developing ethical guidelines for research on wild and captive animals
- Need to look at international forums to use to address issues
- We should discuss NMFS stock assessment analyses further
- We should discuss what species, impacts, and issues are the highest priority (acute and chronic, big loud sources, long-term impacts, etc.).
- We need more facts about the stranding events before we can discuss them (NMFS agreed to look into availability of stranding reports for Bahamas and Puget Sound incidents.)
- We need information on biological sounds in the ocean.

Public Comment

Adel Hashad, Space and Missile Systems Center, U.S. Air Force further explained that the U.S. Air Force is using models to determine underwater exposures to airborne sound. Current models assume a flat surface, but a wavy action creates a second pressure in the order of 140-160 dB between 5-10 kHz as shown in laboratory tests. The U.S. Air Force does not have the funding to verify the laboratory results in the field, but is asking Congress to make money available to fill this data gap.

Bill Rossiter, Cetacean Society International, asked the Committee to consider the need for ethical guidelines in its deliberations and to be unequivocal about its recommendations. If the Committee is willing to kill animals for the sake of research, it should say so and accept the challenge. The Committee should not shirk the difficult questions.

Dan Costa, University of California at Santa Cruz urged the Committee to address habitat degradation and populations. Behavioral studies are critical to understanding, but fundamental questions such as, “What constitutes adverse behavior?” are important to define. Unless you can tell where an animal is and know that an animal can tell where a sound is coming from, it may be difficult to test its response. What is important to an animal will vary among individuals and species. The Committee must

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also realize that models need to be empirically validated. The Committee should also consider pinnipeds, which are more closely related to dogs and bears than they are to cetaceans and may be uniquely impacted. There are existing ethical guidelines and requirements for treatment of research animals. The Committee does not need to start from scratch. Many permit applications are withdrawn in order to avoid denials. It is important to understand that research funded to date has been mission-driven and forced to answer specific questions (e.g., impacts of minerals exploration and national security). It would be beneficial to get NASA, EPA, NIH, and NSF into collaboration on research. Controlled animal studies working in the wild are valuable and should be continued.

Small Group Discussions

The Committee was divided into four groups balanced by interest and asked to discuss the following question for 45 minutes.

What would be the most useful and important elements of a synthesis of current knowledge about marine mammals and anthropogenic sound?

The reports from all of the groups are included in Attachment 3. These reports do not represent any consensus among the group, but rather reflect the results of a brainstorm discussion.

DAY THREE – Thursday, February 5, 2004

Suzanne Orenstein explained that the agenda for the day had been adjusted in response to suggestions made on Day Two to move some of the agency presentations to the morning session. The Committee's discussion of its operating procedures began during the morning session, and was continued after the presentations on relevant government programs. The summary of both sessions on the Operating Procedures is included later in this document.

Panel: Overview of Relevant Government Programs

Marine Mammal Commission - Presentation by Mike Gosliner, General Counsel

The Marine Mammal Commission was established in 1972 when Congress enacted the Marine Mammal Protection Act (MMPA). The Commission consists of three presidentially-appointed Commissioners and a nine-member Committee of Scientific Advisors. The Senate must confirm the Commissioners. The Commission is an independent agency within the Executive Branch; it plays an oversight and advisory role to the decision-making agencies.

The duties of the Commission are to:

- review U.S. activities pursuant to laws and conventions relating to marine mammals;
- review all permits for scientific research;
- undertake, or cause to be undertaken, studies necessary to further the purposes of the MMPA;
- recommend to federal officials actions necessary or desirable for the protection and conservation of marine mammals; and
- recommend to Congress and agencies measures to further the policies of the MMPA.

The MMPA requires that agencies respond to the Commission's recommendations within 120 days, by either adopting them or providing an explanation of reasons why the recommendations were not

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adopted. The agencies are also required to provide the Commission with access to all studies and data regarding marine mammals.

The Commission develops and uses scientific information in several ways, including providing funds for research, commenting on the validity of and conditions for research permits, tracking research done by others, and recommending research activities through comments or authorizations.

The Commission comments on two types of authorizations for takings as defined under the MMPA: small take authorizations, which must meet the standard of negligible impact; and scientific research permits, which must further a “bona fide” scientific purpose and comply with other statutes and requirements. The Commission is responsible for overseeing the adequacy of agency programs, population monitoring, and efforts to understand the nature, significance, and magnitude of sound sources. The Commission interacts with Congress by recommending legislation including statutory changes, funding, and oversight.

Question. Could you please explain the clearance process the Commission will undertake for work by this Committee? **Response by Mr. Gosliner.** As David Cottingham explained earlier, he has talked to both the Office of Management and Budget (OMB) and Council on Environmental Quality (CEQ) about the work of the Committee, and will continue to keep them and the Committee informed of these conversations. OMB may review the eventual product; it is most likely to care about the financial impacts of recommendations coming from the Committee. Many of the other agencies who would review the Committee report are members of the Committee. Whatever the Commission sends to Congress must be vetted through OMB and CEQ, but the Committee’s report to the Commission is independent of that.

Question. How do you report up through the Executive Branch? **Response by Mr. Gosliner.** We clear everything through our Commissioners, who are presidential appointees. We provide recommendations directly to the other agencies. Our communications with Congress must be vetted through OMB and CEQ. We report to CEQ, which is responsible to OMB and is part of the Executive Office of the President at the White House.

Question. Does the Commission have an interpretation of the new MMPA language in the 2004 Defense Authorization Act? **Response by Mr. Gosliner.** Not at this time.

Question. How does the Commission decide what research to fund? **Response by Mr. Gosliner.** We rely on our Commissioners, Committee of Scientific Advisors, and staff to determine how we use our research budget.

Question. What is the annual research budget for the Commission? **Response by Mr. Gosliner.** It varies between 10s and 100s of thousands of dollars.

National Marine Fisheries Service - Presentation by Laurie Allen, Director, Office of Protected Resources

The National Marine Fisheries Service (NMFS, also known as NOAA Fisheries) is responsible for implementing the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA), through which it is mandated to address all forms of noise for all living marine resources. The MMPA prohibits the “taking of any marine mammal on the high seas by any person subject to the United States, with exceptions.” The MMPA also mentions maintaining marine mammals as functional elements of

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ecosystems. Under the MMPA, “take” means to (or attempt to) “harass, hunt, capture or kill any marine mammal.” The MMPA allows for incidental take of small numbers of marine mammals by those engaged in specified non-fisheries maritime activities within a specified geographic area. Such takings are defined in two ways. Level A is injury. Level B is harassment. Such takings can have no more than a negligible impact on the species or stocks, can take only small numbers, must not adversely impact the availability of marine mammals for subsistence use by Alaska natives, and must have prescribed mitigation that results in the least practicable adverse impact. The ESA similarly prohibits taking of marine mammals listed as threatened or endangered.

NMFS also approves permits for research on marine mammals under the MMPA, and under the ESA for listed species. General research authorizations are granted when only Level B harassment is anticipated. If Level A harassment is anticipated, applicants for individual research permits must: show no significant adverse impact on the species or stock; be a *bona fide* scientific activity; provide for the health and welfare of animals; contribute to the understanding of the biology or ecology of the species or stock; and be consistent with the ESA in that the action cannot jeopardize the existence or recovery of a listed species.

NMFS obtains and develops scientific information by funding external studies, convening scientific panels, conducting peer-reviewed research/analysis, and completing scientific literature searches. NMFS focuses on science questions that support the implementation of its laws and attempts to fill data gaps.

Current work on noise and marine mammals that NMFS is undertaking includes:

- developing science-based acoustic exposure criteria;
- partnering with state, federal and private entities to fill acoustic data gaps;
- developing better decision and administrative processes;
- conducting public education and outreach (e.g. lecture series at aquaria), especially with applicants; and
- addressing gaps in stock assessments.

In the future, NMFS plans to develop acoustic exposure criteria that take into consideration cumulative effects, and to partner to develop a global noise-monitoring network to systematically measure noise in the marine environment.

NMFS hopes that the Committee will provide comments on the application of the noise exposure criteria under development. It also hopes the Committee will inform Congress of the complexities of the marine noise issue and problems associated with research and measurement. Finally, NMFS hopes the Committee will identify new means of addressing effects of noise on marine environments.

Question. Will we see the noise exposure criteria in April? **Response by Ms. Allen.** Yes, we will have something ready to present at that time.

U.S. Fish and Wildlife Service Marine Mammal Program - Presentation by Martin Kodis, Chief of the Branch of Resource Management Support

The same laws govern the U.S. Fish and Wildlife Service (USFWS) as the National Marine Fisheries Service (NMFS), but its jurisdiction is limited to the polar bear, walrus, sea otter, marine otter, three species of manatee, and the dugong.

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USFWS manages two stocks of polar bears. There is little information about the potential effects of noise on polar bears, but the Service's greatest concern is the disruption of denning activities. USFWS requires avoidance areas of one mile around known dens and is working with the oil and gas industry to monitor the bears and conduct research. Bears normally swim with their heads above water so it is unlikely they would be seriously impacted by underwater sounds.

USFWS manages one stock of walrus in the Pacific. Like other pinnipeds, they have good underwater hearing capability and they may communicate with each other underwater. The Service does not have a good understanding of impacts of noise underwater. However, walrus seem very sensitive to noise when they are hauled out on land, and since many important activities such as breeding, raising and nursing young, resting and molting happen on land this sensitivity could be particularly important, especially for mothers and calves. Current regulations prohibit fishing closer than 22 km away from haul-out sites in Russia and in Bristol Bay.

USFWS manages five stocks of sea otter; three in Alaska, one in Washington and one in California. They communicate through vocalizations above water and have the potential to be disturbed by sounds, especially high frequency sounds. For example, pier and dock construction noise has been shown to cause disorientation, the bends, ear damage and death in sea otters. Airborne noise may cause them to abandon an activity or an area.

USFWS manages five stocks of manatees. Studies suggest manatees can hear low-frequency sounds. It is hypothesized that they have difficulty localizing sounds and may have a greater low-frequency sensitivity than other animals. Mr. Kodis stated that they are the group of most concern with regard to noise, and may be affected by blasting, minerals exploration, and other coastal activities.

In summary, Mr. Kodis noted that:

- There are potential impacts to USFWS marine mammals on land and in water due to anthropogenic sound.
- More information on impacts is needed for all marine mammals managed by USFWS.
- The USFWS's marine mammal program is small and limited in its ability to assess the impacts of sound on Service trust species.
- USFWS species should be considered in the deliberations and products of the Committee.

Question. Are there any issues from boat traffic and personal watercraft for otters? Are otters affected by noise? **Response by Mr. Kodis.** I am not aware of specific issues with boat traffic and personal watercraft, but law enforcement efforts prevent people from chasing otters with small watercraft. We don't have enough information to understand how concerned we should be about otters, but suspect temporary disturbance problems exist.

Question. How certain are you about the walrus populations and stock structure? **Response by Mr. Kodis.** Few data are available for walrus, so we treat them as only one stock. Our abundance estimates are outdated. We have recently received an appropriation to develop new population estimates for walrus using thermal imagery.

Comment. Otters are of great concern in California, and should be considered in the Committee's deliberations.

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Minerals Management Service – Presentation by Dick Wilderman, Chief Environmental Division, Office of Offshore Mineral Management

The Minerals Management Service (MMS) regulates the offshore oil and gas industry and non-energy mineral extraction. It is the responsibility of the MMS to achieve a balance between mineral resource development and environmental protection. Much of the activity MMS regulates is in the Gulf of Mexico, where the trend is for activities moving into deeper and deeper water. Sources of noise from MMS-regulated industry activities include: seismic surveys, operating drilling structures and rigs, helicopter and vessel traffic, and explosive removal of structures.

The MMS must comply with four major environmental statutes: the Endangered Species Act (ESA), the Marine Mammal Protection Act, the National Environmental Policy Act (NEPA) and the Outer Continental Shelf Lands Act. MMS uses Section 7 of the ESA to consult with the National Marine Fisheries Service and U.S. Fish and Wildlife Service on issues related to endangered species. For protected species, MMS analyzes impacts, designs mitigation and monitoring systems, and provides information to support regulation of its industries. It implements regulations through lease stipulations, permits or operating plans, or notices to lessees. It also works to integrate information and analysis into future regulations.

Under the Outer Continental Shelf Lands Act, the MMS has funded more than \$750 million in research and other activities since the mid-1970s to predict, assess, and manage impacts on the human, marine and coastal environments that may be affected by oil and gas activities. This includes research to protect and enhance protected species and their habitat. Historically this money has been used for research to address NEPA issues and to support ESA Section 7 consultations. Some of the relevant studies in which MMS has participated include:

- Impacts research (Sperm Whale Seismic Study in the Gulf of Mexico: tagging, Controlled Exposure Experiments).
- National Research Council's panel on Characterizing Biologically Significant Marine Mammal Behavior
- Surveys for population and distribution of marine mammals, cetacean abundance in the Gulf of Mexico (GulfCet), and bowhead whale aerial survey (BWASP), and cetacean and turtle abundance (CeTAP).
- Peer reviewed publications including a bowhead whale book.

After 30 years of study, research results to date indicate that potential effects of industry noise on marine mammals will be difficult to detect and open to debate. It is a challenge to differentiate between normal behavior and harmful changes. It is necessary to look at impacts to both populations and individuals. MMS has adopted an adaptive management approach to establish the basis for new mitigations that evaluate the potential regulatory costs, mitigation effectiveness, and technical feasibility.

MMS hopes that participation on this Committee will help put its contributions and responsibilities into a broader context and assist it in finding additional ways to leverage research and jointly-fund work. The challenge for MMS is to maintain a balance between protection of marine mammals and maintaining a significant contribution toward meeting national energy needs. Mr. Wildermann noted the importance of considering how the impacts of noise from offshore oil and gas compare to effects from other activities such as commercial fisheries, recreation and tourism, and marine transportation. He also noted that this issue has the potential to impact national energy policy as the industry continues to move toward deeper water and subsurface activities.

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There were no comments or questions.

Overview of National Science Foundation Programs Relating to Marine Mammals- *Presentation by James Yoder, Director, Division of Ocean Sciences*

The National Science Foundation's (NSF) mission is to support basic, curiosity-driven research in a competitive and peer-reviewed process. NSF research is not directed research, rather it accepts proposals that academics see as important. The Ocean Science Programs include: biological, chemical and physical oceanography; marine geology and geophysics; ocean technology development; dedicated educational activities; large shipboard equipment and shared-use instruments; and academic fleet, submersibles, and scientific ocean drilling. NSF is the primary funder of university research vessels. The Biology Directorate of NSF supports research on animal behavior. The NSF Education Directorate supports education and outreach programs to disseminate information.

NSF supports basic marine mammal research and has cooperated with other organizations through the National Ocean Partnership Program (NOPP) to direct some research on marine mammals and collaborate with other entities to do so. The total funding for directed research on marine mammals is approximately \$2 million/year. NSF also supports oceanographic research that uses sound sources, including seismic research.

NSF spends approximately \$1 million/year for environmental assessments related to MMPA and ESA requirements and for activities required as conditions for receiving Incidental Harassment Authorizations from National Marine Fisheries Service (NMFS). Dr. Yoder noted that these efforts are seen as contrary to NSF's main mission because they do not generate new knowledge (e.g., through basic research).

Dr. Yoder expressed NSF's concern about the cost of time and money to be in compliance with MMPA and ESA. This cost of compliance reduces funds available for research. NSF would like the Committee to consider whether there is a better way. The threat of litigation is onerous to university investigators who use sound sources for their research. They do not have the legal support network and may not be comfortable taking on the risk of litigation.

Question. After the incident with the RV Ewing in the Sea of Cortez in 2002, has NSF made changes to its environmental review? Which researchers have to comply with permitting requirements?

Response by Dr. Yoder. We now seek permits. Even before the incident we were working with Lamont-Doherty Earth Observatory to make sure we conducted the appropriate environmental reviews and we are continuing to do so. We wonder about the potential for treating research like fishery bycatch, wherein fisheries are given a general, limited take authorization.

Question. Are you suggesting that we require some, but not all, introducers of sound to comply with environmental laws? **Response by Dr. Yoder.** We would like to see the Committee discuss this topic. For example, the fishing industry is exempted from small take prohibitions. We are not seeking exemptions, but we would prefer to put money into gathering information, as a way to meet our legal requirements. We are not asking for an exemption, but rather to figure out the best way to use our resources and comply with legal requirements. NSF and NMFS are already looking at addressing these issues through mechanisms within the current laws.

Comments

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- The Defense Department received exemptions from MMPA. There is a legitimate concern that others interests will get exemptions and those exemptions will further weaken the law.
- Recent application of MMPA requirements to academic research may have surprised some researchers, but permits and legal requirements should not be considered “barriers to research.” We need programmatic approaches to permitting.
- The threat of litigation is a barrier to research.
- There are 17 federal agencies that have some jurisdiction over environmental issues related to oceans and marine mammals. National Oceanographic Partnership Program (NOPP) was intended to help deal with that problem. Permitting for researchers should be discussed fully by the Committee soon to address the confusion and delay caused by the number of jurisdictions and requirements.

U.S. Navy Overview - *Presentation by RADM Steven Tomaszewski, Oceanographer of the Navy*

The Navy addresses compliance in three major areas: environmental regulations; navy internal instructions; and At-Sea Policy. Environmental regulations include the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), and the Marine Mammal Protection Act (MMPA), as well as Executive Order 12114. Navy internal instructions are publicly available. The Navy's At-Sea Policy (December 2000) deals with issues of shipboard training, operations orders, routine exercise protective measures, and guidance for fleet exercises. The Navy hopes to release specific exercise guidance to the fleet by spring 2004. In addition, the Navy provides information for environmental processes, as well as more basic research on marine mammals and sound, as noted earlier.

Navy marine mammal protective measures generally apply to training and include a planning component that considers historical marine mammal location information during exercise planning. The Navy also uses 24-hour passive and active detection and lookout programs and does pre- and post- event monitoring for marine mammals. Operational restrictions also come into play including buffer zones, cancellations, delay or alterations of operations, reduced power to sonar and duty cycles, limited nighttime and adverse weather operating conditions, preference to train in deep water and simulated choke point transit operations. The Navy constantly addresses challenges in marine mammal protection. For example, mitigation methods reduce the impact of training realism, and data to support compliance activities is limited.

The Navy marine mammal research program intends to spend over \$10 million on research in 2004. It has spent \$7-10 million per year since late 1990s and is looking at over \$10 million per year for the next five years. This represents 70% of the U.S. government contribution to marine mammal research and 50% of the worldwide marine mammal research budget. Research activities have addressed sound energy source and propagation characteristics; location and abundance of marine mammals; criteria and threshold in measuring degrees of physical and behavioral effects; and mitigation techniques. Some highlights of Navy research include:

- Established acoustic safety criteria based on temporary threshold shift;
- Developed acoustic datalogger tags (D-tags) now used for controlled exposure experiments (CEE) and other purposes;
- Developed marine mammal monitoring on Navy ranges (M3R), utilizing existing Navy assets to do passive acoustic monitoring;
- Developed Argos satellite tags; and

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- Produced Marine Resource Assessments that consolidate environmental information about Navy marine operating areas.

Over 50 publications on marine mammal research sponsored by the Office of Naval Research appear each year in peer-reviewed journals. The Navy has participated in National Research Council (NRC) studies and Board of Visitors review programs.

The National Defense Authorization Act waiver recently approved by Congress is part of our compliance system. This waiver process for the MMPA is to be used for emergencies only, and is not a blanket exemption. Such waivers exist for most other environmental statutes. There have only been two waivers used in the last 25 years. In order to use the waiver, the Navy must consult with the Senate and House Armed Forces Committees, and the Secretaries of Commerce and Interior. The change in the harassment definition that was part of the Defense Department budget authorization implements the recommendations from the NRC, as does the change in the 'small numbers' requirement. Overall, the changes to the MMPA in the National Defense Authorization Act are intended to reduce legal vulnerability for worldwide operations while allowing us and the regulators to focus limited resources on activities that truly affect the health of the animals.

Question. In 1994 the Navy conducted a ship shock trial in the Channel Islands without an Environmental Impact Statement or permit. Natural Resources Defense Council (NRDC) sued after trying to talk with the Navy. The Navy changed its behavior, and litigation on this issue is no longer necessary. Similarly, NRDC contacted the Navy to work on the issue of mid-frequency sonar, but has not been successful. Can you recommend a useful way of engaging on issues that does not end up in court? **Response by RADM Tomaszewski.** The democratic process points out mistakes, and pointing out non-compliance through the legal system is appropriate. The Navy responds and changes its behavior in matters that do not impact national security. Mid-frequency sonar has been around since the 1940s and is the backbone to the Navy mission. The Navy is looking for science to determine whether or how sonar affects marine mammals. So far, we only believe that it disturbs marine mammals. The Navy's view of the impacts of low-frequency active (LFA) sonar is that they are negligible.

Question. Are the documents you refer to in your presentation unclassified (e.g., the protective measures protocol.) If so, can we review them and perhaps help develop them more fully? **Response by RADM Tomaszewski.** Some are. We will investigate what can be made available to the Committee, and how others could get involved in reviewing them.

Question. Are sonar operators trained in the specifics of marine mammal identification and the MMPA? Are they trained to distinguish between whales and ships or military targets? **Response by RADM Tomaszewski.** I don't know what the specific curriculum states, but can speak from personal experience. There is the basic understanding that if you hear a whale, you do not operate. There may be a need for additional training. The assessment protocol under development addresses this, but it is not operational yet.

Question. How does the U.S. operate regarding marine mammal protection when it is within Australian waters? **Response by RADM Tomaszewski.** The U.S. operates following Australian rules or the more stringent among any other collaborating countries. The officer in tactical command sets the rules, and may be from outside the U.S. when Navies are working together. We do not violate U.S. rules even when operating in other waters.

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Comment. The interpretation that the revision of the harassment definition is consistent with NRC recommendations is incorrect. The completion of the Environmental Impact Statement for the ship shock program was the appropriate thing to do. It is preferable to discuss environmental impacts in advance rather than resorting to litigation after the fact. The Navy has made good changes since the Bahamas incident, but much more could be done.

The Role and Responsibility for Protection of Marine Mammals by the States - Presentation by Sara Wan, California Coastal Commission

State governments may use several regulatory avenues to address adverse impacts to marine mammals from underwater noise. Ms. Wan noted that, while each state has its own unique systems, California provides one useful example of how states can deal with this issue.

In California, one avenue to address impacts to marine mammals is to use state law working through the State Lands Commission, California Coastal Commission, and Department of Fish and Game. As the owner of tidal and submerged lands, the California State Lands Commission (CSLC) can limit uses to those activities consistent with the public trust, and can issue leases and permits for activities in tidal and submerged lands. For example, the CSLCS will not authorize high-energy seismic activity in state waters due to concerns regarding the impact of sound. The California Department of Fish and Game regulates the use of explosives, deals with oil spills, and designates and manages Marine Protected Areas. The California Coastal Commission (CCC) has authority through the California Coastal Act (CCA) and Coastal Zone Management Act (CZMA) to review all development in the coastal zone (reaching out to 3 miles offshore). The CCC is charged with protecting the marine environment and sensitive habitats and has broad authority to address noise issues. It regulates uses of the coastal zone with coastal development permits. For example, in 1997 the CCC required marine mammal monitoring and avoidance as conditions for demolition of a decommissioned pier and wharf. Many states also have separate permit jurisdiction over any activities within state waters.

The second major regulatory avenue available to the states is the application of the CZMA. The federal CZMA, passed in 1972, expanded the role of states to activities occurring outside of their waters. It allowed for coastal states and territories to review federal activities that affect each state's coastal zone, both when those activities occur inside and outside of state waters. Administered from the NOAA's Office of Ocean and Coastal Resource Management (OCRM), the CZMA creates a state-federal partnership, which leaves day-to-day management to the 34 states and territories with federally-approved CZM programs. Once a state CZM program is in place, the law requires that federal agencies conduct their activities (e.g., permits, licenses) consistent with the state CZM programs. While failure to grant a consistency certification is not the same as a veto by the state, if unresolved disagreements linger, either party may litigate and conflicts are mediated by the Secretary of Commerce. Consistency reviews are not based on the actual location of the activity, but rather on the location of the impacts, which may occur outside the state's coastal zone. To date Maine, Hawaii and California are the only states that have used or considered using the CZMA authority to address acoustic impacts.

The CCC has concerns about the lack of adequate information upon which it must make its consistency determinations. It is also concerned about the challenges involved in effectively using scientific information in its decision-making and policy setting.

Question. If science is being used to inform policy, what are the key impediments to integration of the two? **Response by Ms. Wan.** The question of how to translate science into permit conditions and how

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precautionary to be are the key impediments. We are also concerned about public response to our decisions.

Question. Is there any statutory or case law on the application of state jurisdiction for affected resources outside the 3-mile state CZM area? **Response by Ms. Wan.** There is a Supreme Court case pending presently, related to oil and gas leasing. There are many other cases that have established this application.

Comment. Scientists also struggle with how to make science relevant, and decision-makers often do not know what to do with the science. There is often a lack of understanding of existing science, and a lack of obvious applications of that science.

Environmental NGO Role in the Regulatory Process - Presentation by Joel Reynolds, Natural Resources Defense Council (NRDC)

Environmental non-governmental organizations play a critical role in environmental enforcement, as representatives of citizens, and as a check on agencies. This role was established through the Administrative Procedures Act and through citizen suit provisions by a Congress mindful of the limits of agency resources. Groups like NRDC have the right to participate in the administrative process through public hearings and comment. They also have many limitations when participating in these processes such as limited opportunity for participation through public notice and comment (limited access to agencies and information); limited funding and staffing relative to other parties; limited application of the outcomes of litigation for enforcement beyond the individual case; and perceptions as being secondary to the agencies or industries involved or an obstacle to moving forward.

NRDC does not believe that a strictly adversarial role for environmental NGOs is what Congress intended. Instead, Congress authorized participation in the initial decision-making process, rather than rely exclusively on after-the-fact litigation, though Congress also recognized the importance of public enforcement by adding citizen suit provisions to most major environmental laws. Congress intended that citizen groups add value to the decision-making and implementation processes as they realized agencies sometimes need help in understanding and enforcing regulations and that maximum efficiency is not always the overriding public value. NRDC's experience in marine mammals bears witness to this. NRDC is dedicated to protecting marine species and oceans because we believe that such protection is critical to the survival of all of us, our children, and the planet. We believe that strong environmental policy is strong economic policy. We have a strong respect for good science although we realize that science also has its limitations, and conservation policy can rarely be determined by good science alone. Where data gaps exist, the precautionary principle must apply.

The Natural Resources Defense Council's 600,000 members have been involved in marine mammal and ocean noise issues since 1994. NRDC prefers collaboration over litigation and only uses litigation as a last resort. Mr. Reynolds noted that NRDC recognizes the importance of national defense, energy development and the use of natural resources, and that it believes that protection of species rarely requires a moratorium, but rather careful planning and honest consideration of alternatives.

Question. Does the Administrative Procedures Act define NGOs? **Response by Mr. Reynolds.** No, the term NGO is not defined in the Acts. An NGO is a non-governmental organization, which can refer to anything from citizen groups to professional associations, etc.

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Question. What was NRDC's involvement in the pulse-power generator acoustic harassment device in 1999? **Response by Mr. Reynolds.** The pulse power generator is a high-intensity, high-frequency acoustic harassment device proposed to be tested by southwest fisheries. Received levels of 205 dB were proposed for sea lions. NRDC and the California Coastal Commission objected to the testing and ultimately the field test was cancelled. **Comment by Sam Ridgway.** Later tests of the device for the National Marine Fisheries Service showed little injury, but also that the harassment devices were not very effective as fisheries deterrents.

Industry NGO Role in the Regulatory Process - Presentation by Chip Gill, International Association of Geophysical Contractors (IAGC)

IAGC appreciates the role of environmental non-governmental organizations (NGOs) and agrees with much of Joel Reynold's presentation. There are many tensions associated with the role of environmental NGOs, but most governments use this system. He noted that Mr. Reynolds' conclusion demonstrates that there is common ground, and expressed optimism that a process like that on which this Committee has embarked gives the greatest opportunity to find that common ground. The geophysical and oil and gas industries are represented by non-environmental NGOs. These industries are highly regulated. The geophysical industry realizes that there are knowledge gaps that affect the regulatory process. Together with the oil and gas industry, it spends roughly \$1 million per year, including in-kind contributions, on environmental research related to sound. The industry is committed to being active in this research. Mr. Gill invited collaboration and funding from environmental NGOs and others to help answer the immediate questions at hand. Mr. Gill noted that providing funding demonstrates industry's commitment to bring solid science to bear on this issue.

Question. Can you clarify what portion of the industry's budget goes to research on this issue and how spending compares to their overall budget? How can the scientific community interact with the oil and gas industry? **Response by Mr. Gill.** The industry currently allocates about \$1 million per year through a small industry coalition for funding research like the Sperm Whale Seismic Study, in cooperation with the Office of Naval Research and National Science Foundation, and it is considering six proposals for 2004. Research to date has mostly been opportunistic, but we are looking to be more targeted. It is the hope that the Committee will help us prioritize. Any suggestions or proposals can be sent to Mr. Gill for consideration by the industry funding coalition.

Review, Discussion and Agreement on Operating Principles for Committee

The Committee reviewed, clarified and made changes to the proposed Operating Procedures in a section-by-section fashion. The Committee did not make it through the entire Operating Procedures document and agreed to complete the discussion at the next plenary session. Changes made at this meeting are noted in the version attached as Attachment 4, which show the revisions in marked text.

Establishment of Subcommittee for Synthesis of Existing Knowledge

David Cottingham opened this discussion by reviewing his vision of a report to address the Committee's charter to evaluate existing information about marine mammals and sound. His view is that the report should build on, and not repeat, the previous National Research Council (NRC) reports, and should identify priorities critical to regulatory decision-making. The idea is that a small Subcommittee representative of the interests included on the overall Committee should work together between Committee meetings to develop a draft of a brief (10-20 pages), digestible report, written for a lay audience, to be distributed to the Committee by the 1st of July for review and discussion at its July 27-29

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meeting. Members on this subcommittee should have a familiarity with past efforts such as the NRC reports. The subcommittee members also may identify other technical resources to consult if they find it necessary to do so.

Discussion. The National Marine Fisheries Service (NMFS) is working on a project that may overlap with some of the charge of the subcommittee (such as the list of data gaps), but that report may not be in layperson terms. NMFS suggested that the Committee wait for the NMFS product before beginning another information review. Other Committee members felt strongly that we should not wait until April to begin this work. There were also concerns that the proposed task was not feasible. After extensive discussion, the Committee as a whole proposed the following interim charge (through the April meeting) and membership for this Subcommittee. It is expected that the Subcommittee will report on its progress at the April meeting and that at that time the charge may be revisited in order to discuss how to incorporate the NMFS synthesis information into the Subcommittee work.

The **Subcommittee's charge** is to address items 1 and 2 in the Committee's Federal Advisory Committee Act (FACA) Charter, as follows:

1. review and evaluate available information on the impacts of human-generated sound on marine mammals, marine mammal populations, and other components of the marine environment,
2. identify areas of general scientific agreement and areas of uncertainty or disagreement related to such impacts.

The following additional questions were suggested during the Committee's discussion of the charge to the Subcommittee.

- What do we know about the effects of anthropogenic noise on marine mammals?
- What is not known?
- What are the acoustic threats to marine mammals? Where are the animals that are impacted? Where are the sound sources that have impacts?
- How can we build on the brainstormed suggestions from small group discussions?

Subcommittee Membership (* denotes those not present and who therefore did not agree on 2-5-04 to accept the nomination)

Bob Gisiner

Roger Gentry or Brandon Southall

Naomi Rose

*Jack Caldwell or *Phil Fontana *Paul Nachtigall

*Jim Kendall (chief scientist for MMS)

Exxon/Mobil representative? (Bruce Tackett will identify)

John Hildebrand

*Jim Miller or *Gerald D'Spain

Between now and the April meeting, the Subcommittee should develop a preliminary summary of the information that addresses its charge using the three NRC reports as a starting point. Additional information incorporating the synthesis developed for NMFS Exposure Criteria and other sources will be added between April and July.

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Lee Langstaff will facilitate this Subcommittee. She will contact those Subcommittee nominees who were not present, and will work with the Subcommittee to schedule and conduct an organizing conference call.

Some Committee members discussed the importance/possibility of beginning the task of developing a summary/analysis of current domestic and international legal authorities, regulatory frameworks, and mechanisms for managing impacts of sound on marine mammals. There was an agreement that the Marine Mammal Commission would consider contracting with someone to summarize the current known regulations and legal frameworks related to sound and marine mammals. The Commission will work with Committee members Sarah Dolman and Erin Heskett who have some materials on this topic already. This document also should be directed at a lay audience.

Planning for Future Meetings

There were a few suggestions about the list of agenda topics for the April 28-30 meeting discussed by the Committee (Attachment 5). They included: 1) put the discussion of the operating procedures first on the agenda; 2) consider working with the State Department in developing the international workshop; and 3) include Bob Gisiner's Effects of Sound on the Marine Environment (ESME) model in the discussion of Examples of Risk Assessment Models. The April meeting will be held at the Sheraton Hotel in Crystal City, VA, on April 28-30.

David Cottingham gave a brief update about the status of the international workshop, summarizing the informal discussion among Committee members on the previous evening. He found strong support for conducting a workshop on international policy and science issues related to marine mammals and sound, and mixed support for holding the workshop in Europe or the U.S. Several Committee members provided information and contacts from past similar workshops and other international efforts, which the Commission will follow up on. Fall remains the preferred time frame for the international workshop.

Suzanne Orenstein reminded the Committee that the third plenary meeting is scheduled for July 27-29 in California. The Commission agreed to send an announcement about their beaked whale technical workshop (April 13-16) to the Committee.

Next Steps

- Distribute meeting summary by e-mail within 6-8 weeks to Committee members and alternates. There will be a 10-day comment period for the summary.
- Distribute revised Operating Procedures within one week of this meeting.
- Schedule organizational meeting of the Subcommittee. This will include contacting suggested members, distributing the revised charge, scheduling a conference call/meeting and facilitating the process.
- Planning for and getting information out about the April Committee meeting.
- Marine Mammal Commission to explore options for developing review of regulatory mechanisms.

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Attachments:

1. Meeting Attendance List
2. Meeting Agenda
3. Small Group Reports
4. Revised Operating Procedures
5. List of topics for Meeting 2

Attachment 1

**Attendance at the First Plenary Meeting of the
Advisory Committee on Acoustic Impacts on Marine Mammals**

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**Attendance at the First Plenary Meeting of the
Advisory Committee on Acoustic Impacts on Marine Mammals**

Committee Members (26)

Laurie Allen	National Marine Fisheries Service
Kenneth Balcomb, III	Center for Whale Research, Inc.
David Cottingham	Marine Mammal Commission
Sarah Dolman	Whale and Dolphin Conservation Society
Chip Gill	International Association of Geophysical Contractors
Marsha Green	The Ocean Mammal Institute
Erin Heskett	International Fund for Animal Welfare
John Hildebrand	Scripps Institution of Oceanography
Martin Kodis	U.S. Fish and Wildlife Service
Kathy Metcalf	Chamber of Shipping of America
Paul Nachtigall	Hawaii Institute of Marine Biology
RAdm. Richard Pittenger, USN (Ret.)	Woods Hole Oceanographic Institution
G. Michael Purdy	Lamont-Doherty Earth Observatory
James Ray	Shell Global Solutions (US), Inc.
Joel Reynolds	Natural Resources Defense Council
Naomi Rose	Humane Society of the United States
Charles Schoennagel	Minerals Management Service
V. Frank Stone	Office of the Chief of Naval Operations (N45)
Frederick Sutter, III	National Marine Fisheries Service
Bruce Tackett	ExxonMobil Corporation
RAdm. Steven Tomaszeski	Office of the Chief of Naval Operations (N61)
Peter Tyack	Woods Hole Oceanographic Institution
Sara Wan	California Coastal Commission
RAdm. Richard West, USN (Ret.)	Consortium for Oceanographic Research and Education
James Yoder	National Science Foundation
Nina Young	The Ocean Conservancy

Alternate Committee Members (12)

Dan Allen	ChevronTexaco Corporation
Diane Bowen	U.S. Fish and Wildlife Service
Daniel Costa	Long Marine Laboratory
Penelope Dalton	Consortium for Oceanographic Research and Education
Gerald D'Spain	Scripps Institution of Oceanography
Philip Fontana	Veritas DGC, Inc.
Michael Jasny	Natural Resources Defense Council
Darlene Ketten	Woods Hole Oceanographic Institution
Sam Ridgway	U.S. Navy Marine Mammal Program
Alexander Shor	National Science Foundation
Donna Wieting	National Marine Fisheries Service
Richard Wildermann	Minerals Management Service

Presenters (5)

Ted Cranford	San Diego State University
David Farmer	Univ. of Rhode Island Graduate School of Oceanography
Michael Gosliner	Marine Mammal Commission
John Reynolds, III	Mote Marine Laboratory
Brandon Southall	National Marine Fisheries Service

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Facilitators and Staff (9)

Alyssa Campbell	Marine Mammal Commission
Tara Cox	Marine Mammal Commission
Michael Eng	U.S. Institute for Environmental Conflict Resolution
David Laist	Marine Mammal Commission
Lee Langstaff	Independent Facilitator
Linda Manning	SRA, International
Suzanne Montgomery	Marine Mammal Commission
Suzanne Orenstein	Independent Facilitator
Erin Vos	Marine Mammal Commission

Observers (82)

Jen Bachus	National Marine Fisheries Service
Lia Barsotti	Canadian Embassy
Linda Bauch	American Petroleum Institute
Joel Bell	U.S. Navy
Colleen Benner	U.S. Commission on Ocean Policy
Jonathan Berkson	U.S. Coast Guard
Matt Burgess	San Diego State University
Jack Caldwell	Western Geco
Christopher Clark	Cornell Laboratory of Ornithology
Mary Cogliano	U.S. Fish and Wildlife Service
Jerry Coombs	Naval Sea Systems Command
Colleen Corrigan	U.S. Fish and Wildlife Service
Alice Crowe	American Petroleum Institute
Marc Dantzker	Cornell Laboratory of Ornithology
Cynthia Decker	Office of the Chief of Naval Operations (N61)
John Diebold	Columbia University
Tanya Dobrzynski	National Marine Fisheries Service
Robert Freeman	Office of the Oceanographer of the Navy
Seth Gabriel	The National Ocean Industries Association
Roger Gentry	National Marine Fisheries Service
Bob Gisiner	Office of Naval Research
Sarah Hagedorn	National Marine Fisheries Service
Adel Hashad	SMC/AXFV Space and Missile Systems Center
Mardi Hastings	Office of Naval Research
Kim Harb	The National Ocean Industries Association
Frank Herr	Office of Naval Research
Ken Hollingshead	National Marine Fisheries Service
Carrie Hubard	National Marine Fisheries Service
Brendan Hurley	University of Vermont
Michael Jeffries	Consortium for Oceanographic Research and Education
Sarah Jensen	AK Eskimo Whaling Comm./N. Slope Bor. Dept. Wildlife Mgmt.
Scott Kenney	U.S. Navy
Curt Kimbel	?
Karen Kohanowich	U.S. Navy
Todd Kraft	U.S. Navy
Anurag Kumar	Geo-Marine, Inc.
Bill Lang	Minerals Management Service
Jennifer Latusek	SAIC
Steven Leathery	National Marine Fisheries Service
Eugene Lee	WWF
Lisa Lierheimer	U.S. Fish and Wildlife Service
Emily Lindow	National Oceanic and Atmospheric Administration

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Ellen Livingston	Office of Naval Research
Jeff Luster	U.S. Navy
Jessica Maher	Office of U.S. Representative Sam Farr
Terri McIntyre	American Society of Mammalogists
Bruce McKay	SeaWeb
Megan McKenna	San Diego State University
Jeannie Mills	Independent Petroleum Association of America
Thomas O'Brien	U.S. Geological Survey
Cdr. James O'Clock, USN (Ret.)	NOAA Marine and Aviation Operations
Bernard Padovani	International Association of Geophysical Contractors
Chris Parsons	George Mason University Dept. of Env. Science and Policy
Dennis Peters	SAIC
Linda Petitpas	Office of the Chief of Naval Operations (N45)
Steven Rabinowitz	Institute for Defense Analyses
Michael Rawson	Lamont-Doherty Earth Observatory
W. John Richardson	LGL, Ltd.
Carol Roden	Minerals Management Service
Bill Rossiter	Cetacean Society International
Lisa Rotterman	Minerals Management Service
Jennifer Salerno	Booz Allen Hamilton
Kerry Ann Sawyer	SRS Technologies
Amy Scholik	Geo-Marine, Inc.
Kimberly Skrupky	National Marine Fisheries Service
Brad Smith	National Marine Fisheries Service
Woody Sutherland	Scripps Institution of Oceanography
Lucinda Low Swartz	Battelle
Julie Teel	Center for Biological Diversity
Phil Thorson	SRS Technologies
Maya Tolstoy	Lamont-Doherty Earth Observatory
Susan Tomiak	Animal Welfare Institute
Jennifer Treadwell	U.S. Navy
Amanda Truett	University of Maryland
Kate VanDive	National Marine Fisheries Service
Deborah Verderame	Naval Sea Systems Command
Brian Weitz	U.S. Senate Subcmte on Oceans, Fisheries, and Coast Guard
Sarah Wilkin	National Marine Fisheries Service
Judy Wilson	Minerals Management Service
Robert Winokur	Office of the Oceanographer of the Navy (N096T)
Mark Xitco	U.S. Navy Marine Mammal Program
David Zinzer	Minerals Management Service

Attachment 2

Meeting Agenda

Attachment 2
Advisory Committee on Acoustic Impacts on Marine Mammals

**Initial Meeting
February 3-5, 2004**

Bethesda Marriott Hotel, 5151 Pooks Hill Road, Bethesda, MD (301.897.9400)

Proposed Agenda

Purpose of this Meeting:

- To develop and agree on the scope of the Committee's efforts and the goal for the process
- To provide a common information base for the Committee to use as it works towards its goal
- To discuss Advisory Committee process and structure and develop mutual expectations among members regarding how they will work together towards a final product

Tuesday, February 3

- 9:00 – 9:45 Welcome and Introductions**
Welcome – *John Reynolds, Chairman, & David Cottingham, Executive Director,*
Marine Mammal Commission
Introduction of Facilitators
Introductions of Committee Members
- 9:45 – 10:00 Review Agenda and Protocols for this Meeting – *Suzanne Orenstein***
- 10:00 – 10:45 Review and Discuss Purpose and Goal for Advisory Committee**
David Cottingham, Suzanne Orenstein, Members
- Background on development of Committee
 - Goal of effort – Report to MMC and then to Congress
 - Overview of Committee meetings and tasks
 - Role of Committee members
- 10:45 – 11:00 BREAK**
- 11:00 – 12:00 Basics of Sound in Water**
Brandon Southall, National Marine Fisheries Service, Office of Protected Resources
- 12:00 – 1:00 LUNCH**

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1:00 – 4:15

(with break)

Sound Sources of Interest or Concern for Marine Mammals

Key Questions:

1. What activities produce sound, how is it produced and for what purpose(s)?
2. What are the characteristics of the sounds produced (frequency, loudness, timing, depth, orientation, etc)?
3. What issues (scientific, policy or other) related to the impacts of sound in the marine environment are most in need of attention currently? In the future?

1:10 – 1:40

Overview of Contributions to Sound in the Marine Environment

(20-minute presentation followed by 10 minutes discussion)

John Hildebrand, Marine Mammal Commission & Scripps Institution of Oceanography

1:40 – 4:50

Panel: Uses and Characteristics of Anthropogenic Sound in the Marine Environment (Each panelist: 15-minute presentation, 20 minutes discussion)

1:40 – 2:15

Oil and Gas Exploration and Production

Jim Ray, Shell Global Solutions, & Phil Fontana, Veritas

2:15 – 2:50

U.S. Navy Activities – *RADM Steven Tomaszewski, Oceanographer of the Navy*

2:50 – 3:05

BREAK

3:05 – 4:50

Continue panel: Uses and Characteristics of Anthropogenic Sound in the Marine Environment

3:05 – 3:40

Shipping – *Kathy Metcalf, Chamber of Shipping of America*

3:40 – 4:15

Acoustic Methods Used in Research – *David Farmer, Graduate School of Oceanography, University of Rhode Island*

4:15 – 4:50

NGO Data and Concerns re: Sound Sources – *Sarah Dolman, Whale & Dolphin Conservation Society*

4:50 - 5 :20

Public Comment

5:20 – 5:30

Summarize Day One and Look Ahead to Day Two

5:30

ADJOURN for the day

5:30 – 7:00

Reception

Wednesday, February 4

9:00 – 9:15

Opening Remarks and Review Plans for Day Two

9:15 – 10:00

Marine Mammals, Hearing and Sound (25-minute presentation, 20 minutes discussion)

Paul Nachtigall, Hawaii Institute of Marine Biology

Key questions:

1. Why is sound important to marine mammals?
2. How do different marine mammals differ in their uses of sound?
3. What are the basics of marine mammal hearing?

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4. What are the critical components of marine mammals' use of sound for evaluating impacts?

10:00 – 12:15 Panel: Impacts of Sound on Marine Mammals

(with break)

(Each panelist: 20-minute presentation, 20 minutes discussion)

Key questions for each panelist:

1. What do we know so far, with what level of agreement?
2. What are the key issues for the future, including mitigation?

10:00 – 10:40 Field Observations of Impacts – *Ken Balcomb, Center for Whale Research*

10:40 – 10:55 BREAK

10:55 – 12:15 Continue panel: Impacts of Sound on Marine Mammals

10:55 – 11:35 Auditory Impacts – *Ted Cranford, San Diego State University*

11:35 – 12:15 Non-auditory Physical Impacts – *Sam Ridgway, U.S. Navy Marine Mammal Program*

12:15 – 1:15 LUNCH

1:15 – 2:35 Continue panel: Impacts of Sound on Marine Mammals

1:15 – 1:55 Behavioral Impacts - *Peter Tyack, Woods Hole Oceanographic Institution*

1:55 – 2:35 NGO Evaluations of Specific Impacts – *Naomi Rose, Humane Society of the U.S.*

2:35 – 3:05 Public Comment

3:05 – 3:20 BREAK

3:20 – 4:15 Small Group Discussions *(Facilitated)*

Discussion Question:

What would be the most useful and important elements of a synthesis of current knowledge about marine mammals and anthropogenic sound?

4:15 – 5:00 Small Groups Report to Plenary; Synthesis of Reports

5:00 ADJOURN for the day

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Thursday, February 5 – As revised during meeting

8:00 – 8:15 Opening Remarks and Review Plan for Day 3

8:15 – 9:30 Review and Agree on Operating Principles for Committee

9:30 – Noon Panel: Overviews of Relevant Government Programs

(10 minutes presentation, 10 minutes Questions and Answers)

Key questions:

1. What are the roles and responsibilities for marine mammals within each agency?
2. How does each agency develop and use scientific information?
3. What are the important issues agencies face in fulfilling their responsibilities currently? In the future?

9:30 – 9:50 Marine Mammal Commission – *Michael Gosliner*

9:50 – 10:10 NOAA Fisheries – *Laurie Allen*

10:10 – 10:30 BREAK

10:30 – 10:50 U.S. Fish and Wildlife Service – *Marty Kodis*

10:50 – 11:10 Minerals Management Service – *Dick Wildermann*

11:10 – 11:30 National Science Foundation – *James Yoder*

11:30 – 11:50 U.S. Navy – *Admiral Steven Tomaszewski*

Noon-1:00 Lunch

1:00 – 1:20 California Coastal Commission – *Sara Wan*

1:20 – 2:00 Role of Non-Governmental Organizations in Regulatory Process – *Joel Reynolds, NRDC, and Chip Gill, LAGC*

2:00-3:30 Continue: Plan for Committee's Future Operations

- Establish Subcommittee for Synthesis of Existing Knowledge for discussion at 3rd Plenary Meeting
 - Charge to the Subcommittee
 - Membership of Subcommittee
 - Schedule
- Plan for 2nd Plenary Meeting on April 28, 29, 30

3:30 – 4:00 Summarize Meeting and Next Steps

4:00 ADJOURN

Attachment 3

**Reports from Small Groups on Elements of Synthesis of Current Knowledge
of Marine Mammals and Sound**

What would be the most useful and important elements of a synthesis of current knowledge about marine mammals and anthropogenic sound?

Group 1

Builds on previous research and includes:

- Research, including National Research Council (NRC) and progress on NRC
- Regulatory schemes
- Vehicles and for a for addressing
- Confidence information re: data
- State of knowledge information from National Marine Fisheries Service (NMFS) exposure criteria
- Data from SOSUS and Mead

Communicates to Congress and includes:

- What all anthropogenic sound sources are
- Sound characteristics
- Where sounds are found geographically
- Estimate of amount of energy that goes into the environment
- What is known about marine mammal hearing
- Data from strandings including non-noise
- Data form monitoring of permits

Issues

- Peer review definition
- Use all information sources and delineate what is peer reviewed

Group 2

Assessment of Noise Levels Over Time

- Ambient (Navy data?), point sources. Medea?

Population Threats

- Basic biology including fish and plankton
- Chronic and acute

Behavioral Aspects

- Mechanism that caused strandings
- Fish

Stock Assessment Reports and Plans

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- Distribution and abundance of species for all species and habitats

Expand to Include all Marine Mammal Species

International Laws and Treaties

- Mass strandings response
- Noise mitigation measures

Funding Sources and Levels

- Who is funding?
- How are they managed?
- What are the priorities?

Group 3

Potential of ways sound impacts marine life including:

- Matrix of impacts at various levels for various species including sound sources (acute, chronic and cumulative)

Sound sources budget

- Expansion of Hildebrand including a geographic distribution of sound sources and impacts

Synthesize stranding information

SEAMAP biogeographic GIS survey including

- Populations, critical habitat, Marine Protected Areas, prey populations

Ecosystem and trophic level impacts

- Fish
- Larval

Programmatic assessment of where Agencies are now

Information that is lacking

Funding

Format:

- Annotated bibliography and availability of sources
- Understandable/plain English
- Include sources of information

Group 4

Need experience outside of the committee (this is a huge task)

Brevity (review NRC results)

Organized indexed reference list (bibliography)

Peer- v. non-peer reviewed information

Identify key policy issues (e.g., research needs in light of policy issues):

- Environment
- Societal
- Economic
- Ethical
- National Security

Expand databases

- Stranding information
- Noise source operational characteristics
- Population assessment
- Other

Assessment of benefits and limitations of different kinds of research

Ecosystem issues (other “critters”)

Attachment 4

Revised Operating Procedures

Advisory Committee on Acoustic Impacts on Marine Mammals

PROPOSED OPERATING PROCEDURES as revised at February meeting

For any voluntary collaborative forum to operate smoothly, it is helpful for those involved to agree at the outset on the purpose for the process and on the procedures by which the group will govern its discussions, deliberations, and decision-making. These draft procedures will be reviewed, discussed, revised and adopted by the Advisory Committee at its first meeting.

1. PURPOSE AND GOAL FOR THE ADVISORY COMMITTEE

The Omnibus Appropriations Act of 2003 (Act), Public Law 108-7, directed the Marine Mammal Commission (Commission) to “fund an international conference or series of conferences to share findings, survey acoustic ‘threats’ to marine mammals, and develop means of reducing those threats while maintaining the oceans as a global highway of international commerce.” [Suggestion was made to add language expanding the list of ocean activities to be maintained. The Commission will draft language for consideration at April meeting. Others also are welcome to do so.] To assist in meeting this directive, the Commission establishes the Advisory Committee on Acoustic Impacts on Marine Mammal (Committee), under the Federal Advisory Committee Act, to:

- 1) Review and evaluate available information on the impacts of human-generated sound on marine mammals, marine mammal populations, and other components of the marine environment,
- 2) Identify areas of general scientific agreement and areas of uncertainty or disagreement related to such impacts,
- 3) Identify research needs and make recommendations concerning priorities for research in critical areas to resolve uncertainties or disagreements, and
- 4) Recommend management actions and strategies to help avoid and mitigate possible adverse effects of anthropogenic sounds on marine mammals and other components of the marine environment.

The Committee's charge is to develop recommendations to the Commission for inclusion in a report to Congress from the Commission. The Commission asks the Committee to develop as much consensus on these recommendations as is achievable. On issues where the Committee does not or cannot reach consensus, this will be noted and the Commission may develop, if it so chooses, its own recommendations to Congress on those issues.

2. STRUCTURE OF THE COMMITTEE

Advisory Committee: The Advisory Committee will consist of those members appointed by the Commission. The full Committee will be the decision-making forum for the Committee. The Commission will have two members on the Committee.

Subcommittees: The Committee may establish subcommittees to assist it in developing draft proposals or products for consideration at specific Committee meetings. The membership of subcommittees is subject to the approval of the Committee and may be drawn from individuals who are not Committee members. All subcommittees work at the direction of and report to the Committee. The Committee will develop a scope of work for each subcommittee, outlining the desired membership and expertise, schedule, and product.

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[Discussed on 2-5-04, but not finalized. Brackets indicate issue to come back to.] Technical Resources: The Commission, [in cooperation with] the Committee, may identify technical resource experts who will be available to assist the Committee or subcommittees in exploring specific questions or topics and in preparing documents for Committee consideration. Technical experts will participate in Committee discussions only with Committee approval.

3. PARTICIPATION

Interests Represented: Committee membership is limited to those appointed by the Commission. The list of appointed members is included in Attachment A.

Responsibilities of Committee Members: Committee members are responsible for representing the views of other members in their constituency to the maximum extent feasible, and for communicating with others in their interest group. Members are responsible for ensuring that all significant issues and concerns of their organizations and constituents are fully and clearly articulated during Committee meetings. Members are also responsible for ensuring, to the maximum extent feasible, that any eventual recommendations or agreements are acceptable to their constituents and/or the agencies or organizations that they represent.

Alternates: Each member is expected to attend all meetings in their entirety. Each member can also recommend to the Commission an alternate who will, upon Commission approval, attend meetings or portions of meetings when the member is unable to fill his or her seat. The Committee does not intend for this provision to allow for the de facto representation of two members from a constituency in one seat. Alternates who attend meetings with their Committee member can address the Committee in the public comment period. It is the responsibility of the member and the alternate to communicate to ensure that there are no disruptions in the process when an alternate joins the Committee deliberations.

Participation of Those Who Are Not Committee Members: Committee members may request to hear from experts who are in the room but are not on the Committee.

Other Commitments of Members: Members are asked to:

- Share all relevant information that will assist the Committee in achieving its goals;
- Keep their organizations' decision-makers informed of potential decisions and outcomes, in order to expedite approval for the final product to the greatest extent possible;
- Resolve issues being addressed within the Committee structure, not through side bar discussions and agreements that may place other Committee members at a disadvantage;
- Refrain from characterizing the views of other Committee members, or the Committee as a whole, in any interactions with the press; and
- Support the eventual product if they have concurred in it.

Addition of Members: Additional members may join the Committee only with the agreement of the Commission and the Committee, and only if they represent an interest that is not already represented.

4. DECISION-MAKING AND COMMITMENT

Consensus: When concurrence among the members is desired, the Committee will make decisions by consensus. The Committee will use the following definition of

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consensus: all Committee members can live with a given recommendation or decision. Committee members are responsible for making known any areas of disagreement throughout the process. If the group cannot reach consensus, members will evaluate the consequences of their disagreement and decide together how to address the lack of agreement. The disagreements will be summarized and can become part of the Committee's report if the Committee so chooses.

Role of the Commission: The Commission will participate as full members of the Committee, engaging in the Committee on the issues and exchanging views on the topics discussed. The Commission will provide technical support to the Committee as requested, to the extent feasible. The Commission intends to use any recommendations on which there is consensus in its report to Congress. On issues where the Committee does not or cannot reach consensus, the disagreements will be described in the Committee report. The Commission will include those disagreements in its report to Congress and may develop, if it so chooses, its own recommendations to Congress on those issues.

Decision-Making Process: Decisions will be made by consensus of those present at the meeting except in the case of concurrence on major products, for which consensus and sign-off from all Committee members will be sought. Major products include draft and final Committee reports.

The following sections were not discussed at the February meeting. They will be discussed at the April meeting. The goal for the April meeting will be to agree on and finalize the complete operating procedures document.

5. SAFEGUARDS

Good Faith: All Committee members agree to act in good faith in all aspects of the Committee's operation. They further agree that specific offers made in open and frank problem-solving conversations will not be used against any other member in future litigation or public relations. Good faith requires that individuals not represent their own personal or organization's views as views of the entire Committee, and that the views and opinions they express in the Committee deliberations are consistent with the views they express in other forums.

Committee Products: The Advisory Committee will develop draft and final reports to the Commission outlining consensus recommendations and areas of disagreement. The Committee may also develop preliminary draft recommendations, chapters of its final report, and other documents that will assist the Committee in reaching consensus on a final report. All agreements on preliminary products will be considered provisional until the Committee has reached consensus or otherwise finalized its final report.

Press: All meetings of the Committee will be open to the public, and members of the press may attend. Committee members and facilitators may speak to the press, but all agree to refrain from characterizing the views of other Committee members, or the Committee as a whole, in any interactions with the press.

6. MEETING PROCEDURES

Steering Subcommittee: If desired by the Committee, a small Process Steering Subcommittee may be formed. Decisions about meeting agendas and other Committee process issues will be made through consultation among the Commission, the facilitation

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team, and members of the Committee who wish to volunteer to play a Steering Subcommittee role. The Steering Subcommittee, if one is formed, will be responsible for managing the Committee's process, in coordination with the Commission and facilitators. The Steering Subcommittee must have representation from the key interest groups to bring a balanced approach to planning for the Committee's efforts.

Caucusing: Any member may request a caucus with any other member(s) at any time. The person requesting the caucus will specify who is included in the caucus and how much time is being requested. (This technique will be most useful when the Committee is working to make decisions or to finalize recommendations.)

Facilitation: The Committee meetings will be facilitated. The facilitators will not take positions on the issues before the Committee. The facilitators will work to ensure that the meetings stay on topic and that all points of view are heard during discussions. Facilitators will keep confidential information disclosed to them in confidence.

Open to the Public: Meetings of the Committee will be conducted consistent with the Federal Advisory Committee Act (FACA), and will be open to the public and announced in the *Federal Register*. Recommendations made by subcommittees will be brought to the full Committee for consideration, and will be posted on the Commission's website.

Meeting Summaries: The facilitators will develop summaries of each meeting, in consultation with the Commission. The summaries will be distributed to the Committee or appropriate subcommittee for review prior to their posting on the Commission's web site. The Committee will have ten days to provide comments and corrections.

Attachment 5

Proposed Topics for Meeting 2

1. Background on Assessing Risk to Marine Mammals from Sound
 - History of criteria development: HESS, NRC panels, MMPA definition of harassment, other?
 - What we learned from stranding analyses re: criteria
 - Overview of efforts of NRC Panel on Defining Impacts of Significance
2. Examples of Risk Assessment Methods
 - U.K. Navy
 - U.S. Navy LFA Studies
 - Efforts to Apply EPA Risk Assessment Model to Marine Mammals and Sound
3. NOAA Fisheries Noise Exposure Criteria
 - Background on development and intended uses
 - Overview of matrix structure
 - Science panel presentations on injury data and behavioral data
 - Identify gaps and limitations
 - Extensive discussion by Committee, with summary of concerns and suggestions for how Committee should integrate Criteria into its work
4. Report from Beaked Whale Workshop
5. Committee Planning
 - Brief report from Sub-committee on Assessment of Knowledge and plan for review of sub-committee product at Meeting Three
 - Finalize Operating Procedures, if not finalized at Meeting One
 - Establish Sub-committee on Management and Mitigation
 - o Charge
 - o Membership